ENGINEERING AND MINING JOURNAL

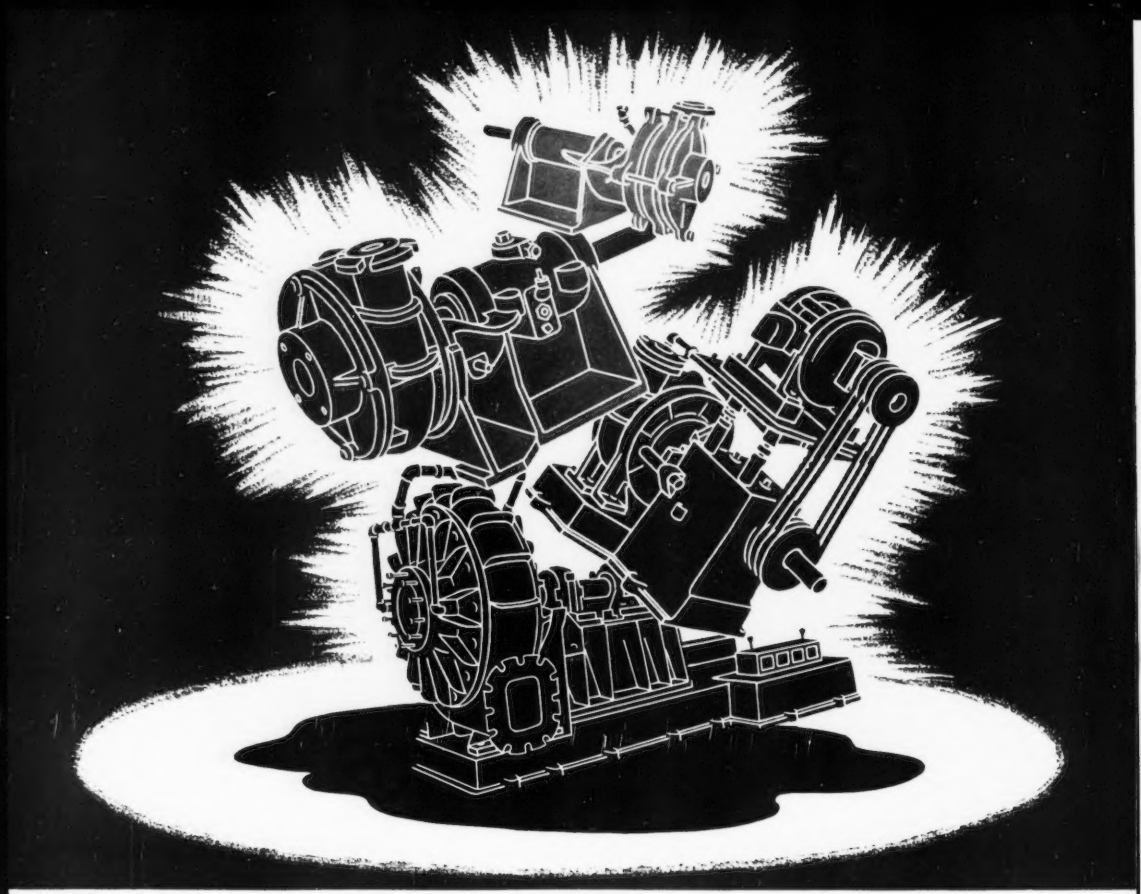
JULY, 1949

A McGRAW-HILL PUBLICATION

MINING LOOKS TO THE FUTURE

Herein is the proud record written by the men of mining, whose vision, enterprise, and skill reach far beyond today, so that all people may enjoy security in mineral supplies tomorrow.

★



MAKING PUMPS DO TRICKS

Never Before Thought Possible in Abrasives Handling

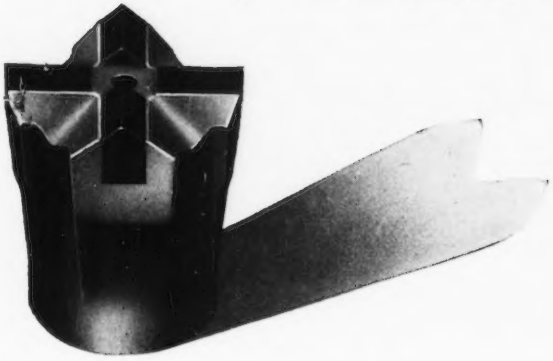
Some of the things our engineers have done with Hydroseal Pumps were thought "almost too good to be true," until the pumping systems started up successfully and continued operating, without a hitch, month after month. A few of our never-done-before pumping jobs have even been scoffed at, yet time proved our engineers were right. A typical example is the pumping of cone discharge from the airlift in heavy-media separation plants. Previously a bucket elevator had been used, but a Hydroseal is now handling this heavy density pulp containing chunks of rock up to 1½", and maintenance is not above normal. . . . The money-saving pumping feats our engineers have made practical for others, can possibly be duplicated for you. If your abrasive material handling can't be done better with Hydroseal Pumps, they will tell you. And remember, our men are not just pump salesmen, they are Abrasives Pumping Engineers, backed by successful experience in unusual pumping jobs. Catalog No. 547 sent on request. *The Allen-Sherman-Hoff Company, 229 S. 15th Street, Philadelphia 2, Pa., U. S. A. Representatives in Most Principal Cities.*

HYDROSEAL SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED

HYDROSEAL, PACKLESS AND MAXIMIX DESIGNS ARE COVERED BY PATENTS AND APPLICATIONS IN THE MAJOR MINING CENTERS OF THE WORLD

Carset Jackbits

Drill faster, 50% or more
Boost tonnage 20% or better
Finish more rounds per month!



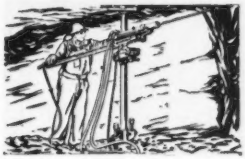
Now it has been Proved that you can do this, and much more, with the I-R CARSET JACKBIT

More than two years of actual field experience have given positive proof of what the CARSET JACKBIT can do – under all drilling conditions, in all kinds of rock. The results today are creating a complete revolution in rock-drilling performance and economy.

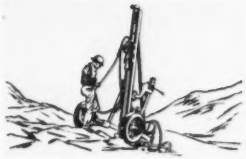
For here is a Carboloy-set bit that is repeatedly out-drilling and out-lasting a steel bit usage by 50-to-1, 100-to-1, and in many cases as much as 400-to-1! Uniformly high drilling speed is maintained for the full depth of the hole – without the progressive slackening in speed of quick-dulling steel bits. Bit changing is practically eliminated, longer steel changes can be used, and single-gauge holes can be drilled to any practical depth. This means more efficient drilling cycles, more rock or ore broken per shift – usually *20%* or more.

For the complete story on the CARSET JACKBIT, write today for your copy of our new 36-page, pocket-size catalog, Form 4091.

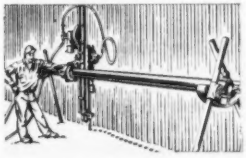
HERE ARE A FEW TYPICAL REPORTS ON CARSET PERFORMANCE



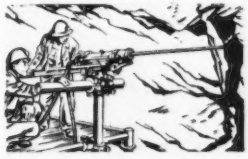
A MINING COMPANY, drilling in a very hard quartzite, reports that CARSET JACKBITS have so multiplied drilling speed that miners can now drill and blast on the same shift. With steel bits, blasting previously had to be done on the second shift. This customer has converted to CARSET JACKBITS 100%.



ON A LARGE DAM PROJECT, 2" CARSET JACKBITS were used with 4" Wagon drills operating in hard dense basalt. These bits drilled 24-ft. holes in 22 minutes, while steel bits previously used required 66 minutes for an 18-ft. hole (with 10 bit changes). Footage was increased from 120 to 261 ft. per shift.



IN A GRANITE QUARRY, CARSET JACKBITS have given such outstanding performance that steel bits are no longer used. Previously, with quick-dulling steel bits, the bit reconditioning shop had to be run two 8-hour shifts a day. This operation has now been almost eliminated.



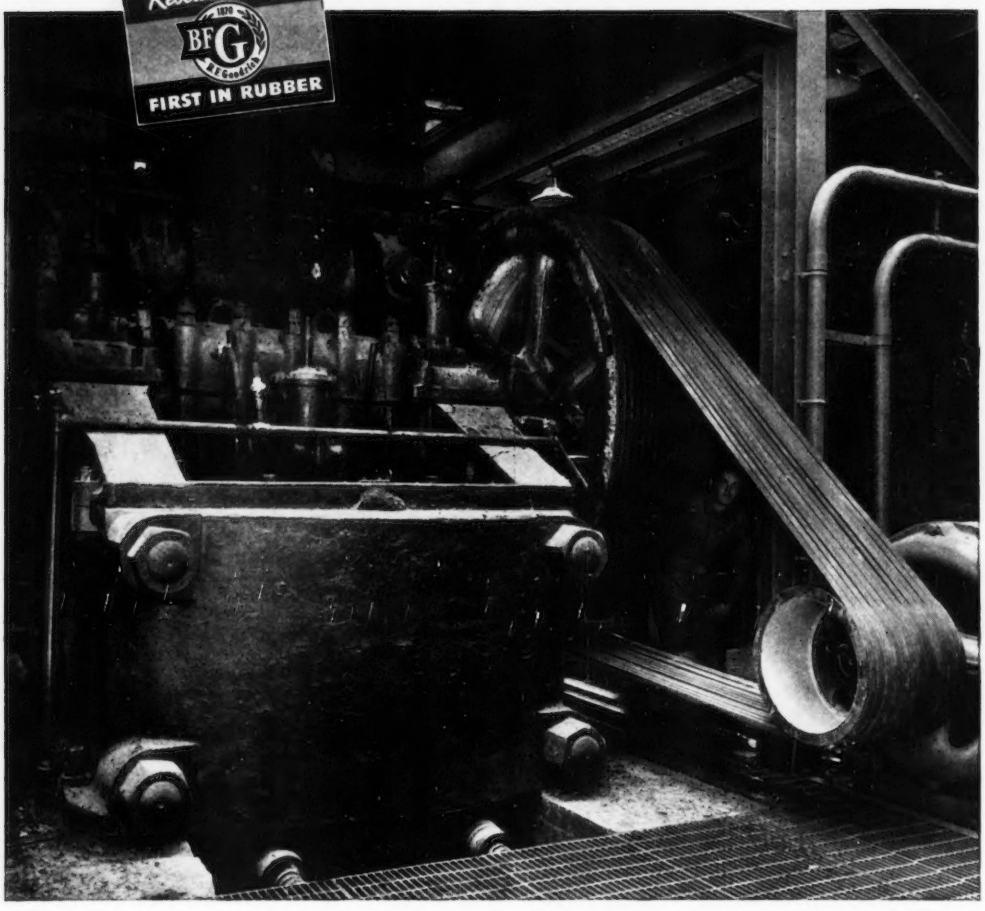
A MINING COMPANY, in driving a 12 x 20 foot 97-hole heading in taconite, required an average of 49.8 hours to pull a 5-foot round. With CARSET JACKBITS they pulled 6½-foot rounds and cut this time to 18.5 hours. Accurate cost records showed a direct saving of $92.69 per foot of drift, or $602.48 per round.

CARSET JACKBIT
THE IR SUPER-BIT
SET WITH CARBOLOY INSERTS

manufactured exclusively by

409-15

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.



The iron giant that chews up rocks

A typical example of B. F. Goodrich product improvement

THAT big chunk of iron is a jaw crusher that breaks rocks as big as table tops. Sometimes a parade of these extra-big rocks comes along, makes the jaw chew extra hard for a time. V belts that drove it (shown at the right) used to stretch under this strain, lengthen permanently. Soon they were running off the pulleys. The quarry people came to B. F. Goodrich about it.

B. F. Goodrich engineers had developed a V belt with a new kind of reinforcement called a "grommet." The belt is more elastic, stands sudden shocks and strain.

The new BFG belts were tried on the crusher. They have already lasted far longer, and they pull their load more efficiently. They are still good for years of driving this rock-chewing monster.

This quarry company followed a good procedure which many other companies employ, too. Instead of accepting the high costs of frequent replacement, they called in B. F. Goodrich—and found exactly what they needed to cut costs and keep their plant running with fewer delays. Even if B. F. Goodrich had not had the needed product, the chances are good that they would soon have developed it, for BFG research is constantly at work to meet "impossible" problems and steadily improve even the most standard rubber products. *The B. F. Goodrich Company, Industrial and General Products Division, Akron, Ohio.*

B.F.Goodrich
RUBBER FOR INDUSTRY

ENGINEERING AND MINING JOURNAL

FOUNDED 1866

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IT COSTS NO MORE TO HAVE THIS PROTECTION AT YOUR MINE . . . .

HAZAPRENE ZBF* SHEATH

Unequalled for Flame-Resistance — standard on all Hazacord Portable Mining Cables

HAZACORD Mining Machine Cables — Fine copper wires, Hazaloy coated or tin-coated for corrosion protection, provide a flexible, easy-to-handle cable. Long-lived, heat-resisting, Performite insulation over the conductors has an operating temperature of 75 C. This provides a safety margin of about 25% to withstand overload surges. Hazaprene fillers (not jute) are used to prevent wicking in of moisture through cable ends. Available in Twin-Parallel, Concentric or Two Conductor Round Types.

*ZBF

ZINC BORATE FORMULA

Flame tests have shown that Zinc Borate imparts greatly increased fire-resistant properties to neoprene compounds with burning rates reduced by as much as 20% and weight losses by as much as 40%. Afterglow is materially reduced also. Millions of feet of cable protected by this type of sheath were used during the war by the Navy for special operating conditions to gain extra fire protection. Hazaprene ZBF Sheaths mean not only greater safety because of unusual flame-resistance and lack of afterglow — but also longer life through increased resistance to abrasion, wear and tear.

In more and more mines every day, electrical men are turning to Hazacords to gain the extra safety provided by the Hazaprene ZBF Sheath. This basic improvement developed by Hazard in neoprene sheaths has all the qualities important to long cable life — oil, water, acid and heat resistance, good flexibility combined with enduring toughness — *plus a resistance to flame never before obtainable.*

And under this Hazaprene ZBF Sheath, you'll find each Hazacord Mining Cable has its individual service-engineered features to assure — from every cable component — safe, trouble-free operation. For complete information, ask your Hazard representative or write Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

TYPE SH-A

HAZACORD Shovel and Dredge Cable — three separate conductors are individually protected with heat-resisting Keystone insulation and color-coded for quick, lasting identification. They are cabled together with Hazaprene fillers for extra flexibility and moisture tightness. A reinforced double layer Hazaprene ZBF Sheath provides over all protection, and, like all Hazaprene ZBF Sheaths, is pressure cured in a continuous metal mold for increased density and long life. Available in Types G, W, and Type SH, which has four different styles to best meet voltage pressures and operating conditions.

HAZACORD Flexible Cords (rated at 600 volts) for hand-held mine drills are protected with this tough, durable Hazaprene ZBF Sheath that withstands the most severe service. Hazacord's safety features have earned approval by law for underground mine use. Each is marked with Pennsylvania Dept. of Mines Approval P104 and more than meets their high standard of flame-resistance. Hazacords are also available in Type SO and SJO to meet every mining need for portable tools, appliances, drop lights, etc.

HAZARD

7474

insulated wires and cables for every mining use

Nine Years on the Job... Crushing Tough Trap Rock

INSTALLED IN 1940 by Bird and Sons, E. Walpole, Mass., this *Type R* gyratory crusher has been in operation 24 hours most days reducing hard, abrasive trap rock for roofing granules.

Trap rock is tough on crushers. Yet, so little "time out" for maintenance has been required since this machine was installed that these owners say it does a remarkable job for this kind of work.

In the modern *Type R* crusher, Allis-Chalmers has achieved both maximum strength and the elimination of excessive weight. It's built of sturdy steel construction with wearing parts made of heat-treated manganese steel. Fully automatic flood-lubrication of moving parts contribute to long operating life. Resilient mountings protect crusher and building from destructive vibration.

Type R crusher gives you maximum crushing capacity. That's due to the scientifically shaped crushing chamber... which also results in a more cubical product.

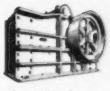
MAINTAINS EXACT PRODUCT SIZE

It's a topnotcher in operating convenience, too. "Speed-Set" control of crusher setting permits adjustment to exacting product size with turn of hand crank ... *easily*, without stopping crusher!

Automatic Reset lowers the entire crushing head hydraulically to pass tramp iron and other uncrushable materials... then brings it back to previous setting smoothly and without shock.

Find out more about *Type R* crusher's cost-cutting advantages from the A-C representative in your area, or write for **Bulletin 07B6006E.** A-C offices or distributors in principal cities in the U.S. and throughout the world.

Kilns, Coolers, Dryers


Jaw Crushers

Hoists

Mills

Gyratory Crushers

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AND OTHER EQUIPMENT FOR THE CRUSHING, CEMENT AND MINING INDUSTRIES

ALLIS-CHALMERS, 969A SO. 70 ST.
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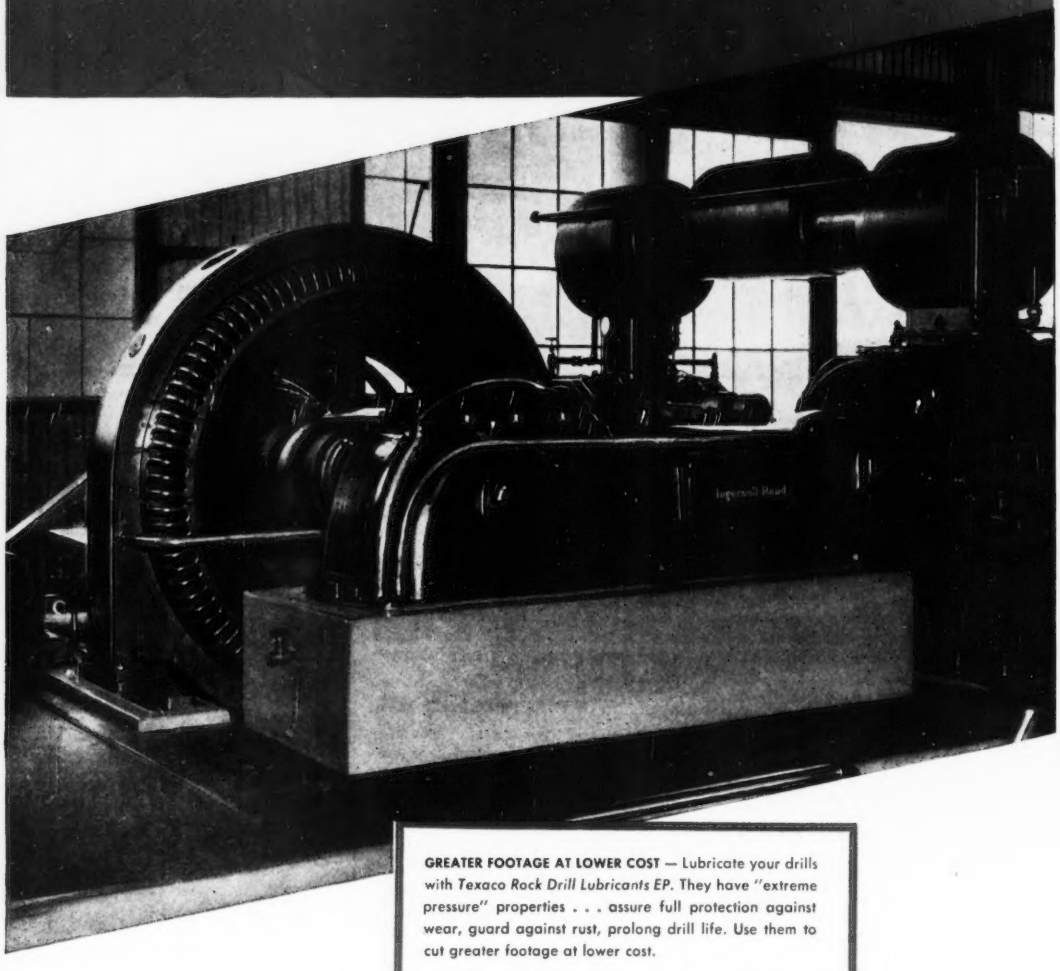
Speed-Set is an Allis-Chalmers trademark

Assure maximum



GREATER FOOTAGE AT LOWER COST — Lubricate your drills with *Texaco Rock Drill Lubricants EP.* They have "extreme pressure" properties . . . assure full protection against wear, guard against rust, prolong drill life. Use them to cut greater footage at lower cost.

TEXACO

TEXACO

compressor efficiency Under All Conditions

Use Texaco air compressor oils and Texaco Lubrication Engineering know-how to help improve your compressor operation

WHATEVER the type or size of your compressors — whatever your operating conditions — there is a specific Texaco air compressor oil that will assure full volume and pressure, longer compressor life, minimum cost for maintenance.

Texaco has a *complete* line of air compressor oils — straight mineral oils for regular service . . . rust-inhibiting oils where rust is a threat . . . heavy-duty oils for unusually severe service or where carbon and gum are problems . . . compounded oils where water is present—oils designed to prevent wear and to keep valves clean, rings free, ports open and air lines clear *under all operating conditions.*

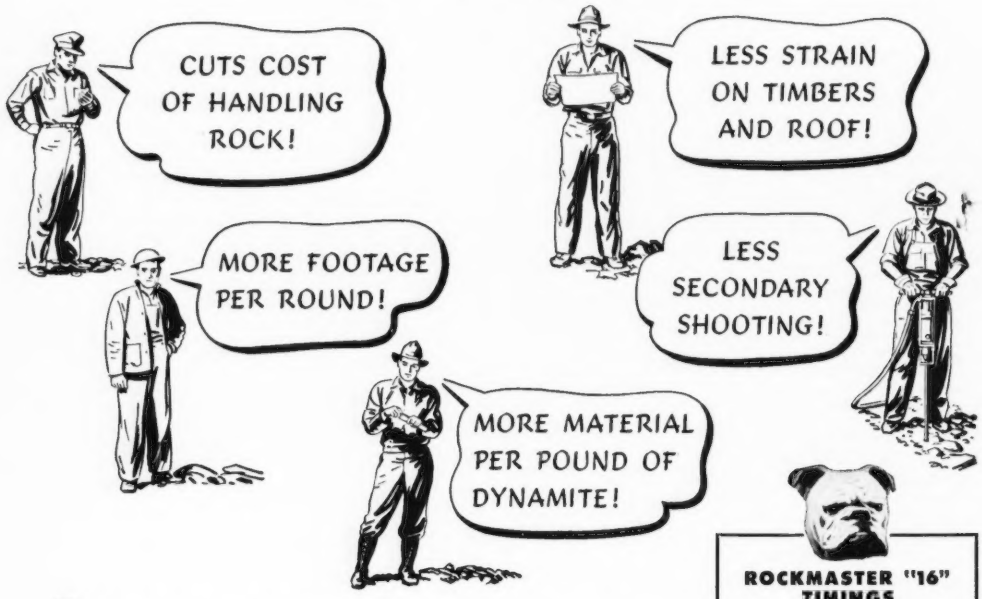
Texaco Products have proved so effective in increasing efficiency and lowering costs in mines everywhere that —

More copper mining equipment in the U. S. is lubricated with Texaco than with any other brand!

Let a Texaco Lubrication Engineer help you select the Texaco air compressor oils you need to assure best results. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 E. 42nd St., New York 17, N. Y.

AIR COMPRESSOR OILS
FOR ALL OPERATING CONDITIONS

What Does the *NEW* ROCKMASTER "16" Blasting System Do for *YOU*?


CUTS COST OF HANDLING ROCK!
LESS STRAIN ON TIMBERS AND ROOF!
MORE FOOTAGE PER ROUND!
LESS SECONDARY SHOOTING!
MORE MATERIAL PER POUND OF DYNAMITE!

THE ROCKMASTER 16 blasting system is the greatest improvement in blasting methods since Atlas introduced ROCKMASTER—the first millisecond delay blasting system! Skilled blasting men have agreed on that point. They can now shoot multi-hole blasts with 17 *different* ROCKMASTER electric detonators, all firing in a fraction over one-half second! No complicated wiring. No complex machine to buy.

Naturally this means better control over breakage than was ever possible before . . . better control over throw, too . . . and over noise and vibration.

Underground, the new ROCKMASTER system provides sufficient delays for complex large rounds. The blaster gets all the advantages of ROCKMASTER'S superior breakage control—*plus* greater safety because of less vibration—less dust—more footage per round.

Get the full story from your Atlas representative. Ask for new booklet explaining the *why*, *wherefore* and *how* of ROCKMASTER.

ROCKMASTER "16" TIMINGS

Rockmaster No.	Avg. Time of Each Delay from Zero (milli-seconds)
0 (zero)	0 (inst.)
1	8
2	25
3	50
4	75
5	100
6	125
7	150
8	175
9	200
10	250
11	300
12	350
13	400
14	450
15	500
16	550

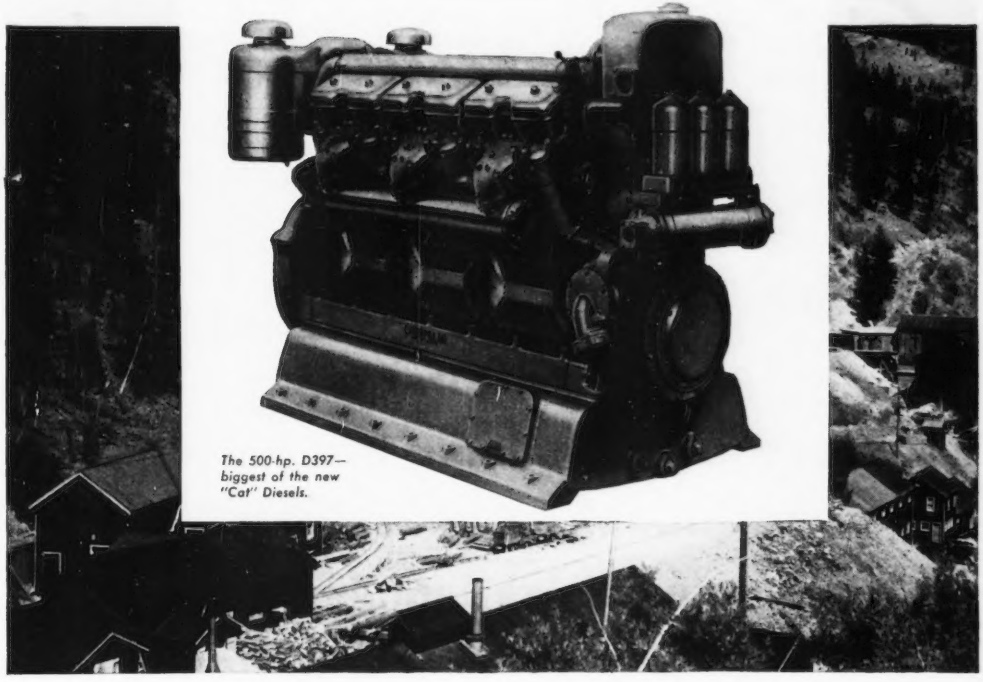
ROCKMASTER: Reg. U. S. Pat. Off.

ATLAS EXPLOSIVES
"Everything for Blasting"

CHEMICALS ATLAS EXPLOSIVES

ATLAS POWDER COMPANY, Wilmington 99, Del. • *Offices in principal cities* • *Cable Address—Atpowco*

New BIG YELLOW ENGINES BUILT TO HANDLE BIG JOBS



The 500-hp. D397—biggest of the new "Cat" Diesels.

MINING MEN the world over have learned from long experience that they can always depend on "those big yellow 'Caterpillar' Diesel Engines." They've proved themselves in shovels, dredges, draglines, compressors, hoisting machinery, and as Electric Sets.

Now you can power even bigger equipment—with new, bigger "Cat" Diesels. In addition to present models, four great new Engines, ranging up to 500 hp., and four new Electric Sets, generating up to 314 kw., are now coming out of the world's finest, most modern engine factory. Every one is designed to burn low-cost, non-premium fuels—assuring substantial savings. Every one is given a closely supervised dynamometer run to assure proper break-in and full horsepower output.

When you buy new equipment, specify "Caterpillar" Diesels for power. And when you consider replacing the power in your present equipment, call on your reliable "Caterpillar" dealer. For immediate information, SEND IN THE COUPON.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

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DIESEL ENGINES • TRACTORS
MOTOR GRADERS
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CATERPILLAR TRACTOR CO.
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Send me specifications on the new "Cat" Diesel Engines and Electric Sets.

Name_____

Address_____

JOY MACHINES

Field-Proved in Service

Made by the world's largest manufacturer of Underground Mining Equipment, and the pioneer in mechanized mining, JOY Equipment can give you the great advantage of

MORE PRODUCTION AT LESS COST

The JOY Line is COMPLETE

Note, in the comparison below, how JOY EQUIPMENT stands out in its ability to take care of Metal Mine Requirements

	JOY	Company B	Company C	Company D	Company E	Company F	Company G	Company H
ROCK DRILLS								
Spaders	YES	YES	YES	YES	YES	NO	YES	YES
Busters	YES	YES	YES	YES	YES	NO	YES	YES
Jack Hammers	YES	YES	YES	YES	YES	NO	YES	YES
Stopers	YES	YES	YES	YES	YES	NO	YES	YES
Drifters	YES	YES	YES	YES	YES	NO	YES	YES
Drill Jibs	YES	YES	YES	YES	NO	NO	NO	YES
Drill Jumbo (Track)	YES	YES	NO	NO	NO	NO	NO	YES
Drill Jumbo (Trackless)	YES	NO	NO	NO	NO	NO	NO	NO
DRILL BITS								
Carbide Bits	YES	YES	NO	NO	NO	NO	NO	NO
Detachable Bits	NO	YES	NO	NO	NO	NO	NO	NO
Thro-Way Bits	YES	NO	NO	NO	NO	NO	NO	NO
HOISTS								
Single Drum Utility	YES	YES	YES	YES	NO	NO	NO	NO
Single and Two Drum Shaft	YES	NO	NO	NO	NO	NO	NO	NO
Two Drum to 15 HP	YES	YES	YES	NO	NO	NO	NO	NO
Two Drum to 125 HP	YES	YES	NO	NO	NO	NO	NO	NO
Three Drum to 15 HP	YES	YES	YES	NO	NO	NO	NO	NO
Three Drum to 125 HP	YES	YES	NO	NO	NO	NO	NO	NO
Sheaves	YES	NO	NO	NO	NO	NO	NO	NO
CORE DRILLS								
Blast Hole	YES	YES	NO	YES	NO	NO	NO	NO
Exploratory	YES	YES	NO	YES	NO	NO	NO	NO
COMPRESSORS								
Portable	YES	YES	YES	YES	YES	NO	NO	YES
Vertical—Air Cooled	YES	YES	YES	YES	YES	NO	NO	YES
Vertical—Water Cooled	YES	YES	YES	YES	YES	NO	NO	NO
Large Heavy Duty	YES	YES	YES	YES	YES	NO	NO	NO
LOADERS								
Scraper Slides	YES	YES	NO	NO	NO	NO	NO	NO
Mine Car Type	YES	NO	YES	NO	NO	YES	NO	NO
Trackless Loaders (Medium)	YES	NO	NO	NO	NO	YES	NO	NO
Trackless Loaders (Heavy)	YES	NO	NO	NO	NO	NO	NO	NO
MATERIAL HANDLING								
Shuttle Cars	YES	NO	NO	NO	NO	NO	NO	NO
Chain Conveyors	YES	NO	NO	NO	NO	NO	NO	NO
Shaker Conveyors	YES	NO	NO	NO	NO	NO	NO	NO
Belt Conveyors	YES	NO	NO	NO	NO	NO	NO	NO
MINE VENTILATION								
Portable Blowers, Electric	YES	NO	NO	NO	NO	NO	NO	NO
Portable Blowers, Air	YES	NO	NO	NO	NO	NO	NO	NO
Large Mine Fans	YES	NO	NO	NO	NO	NO	NO	NO

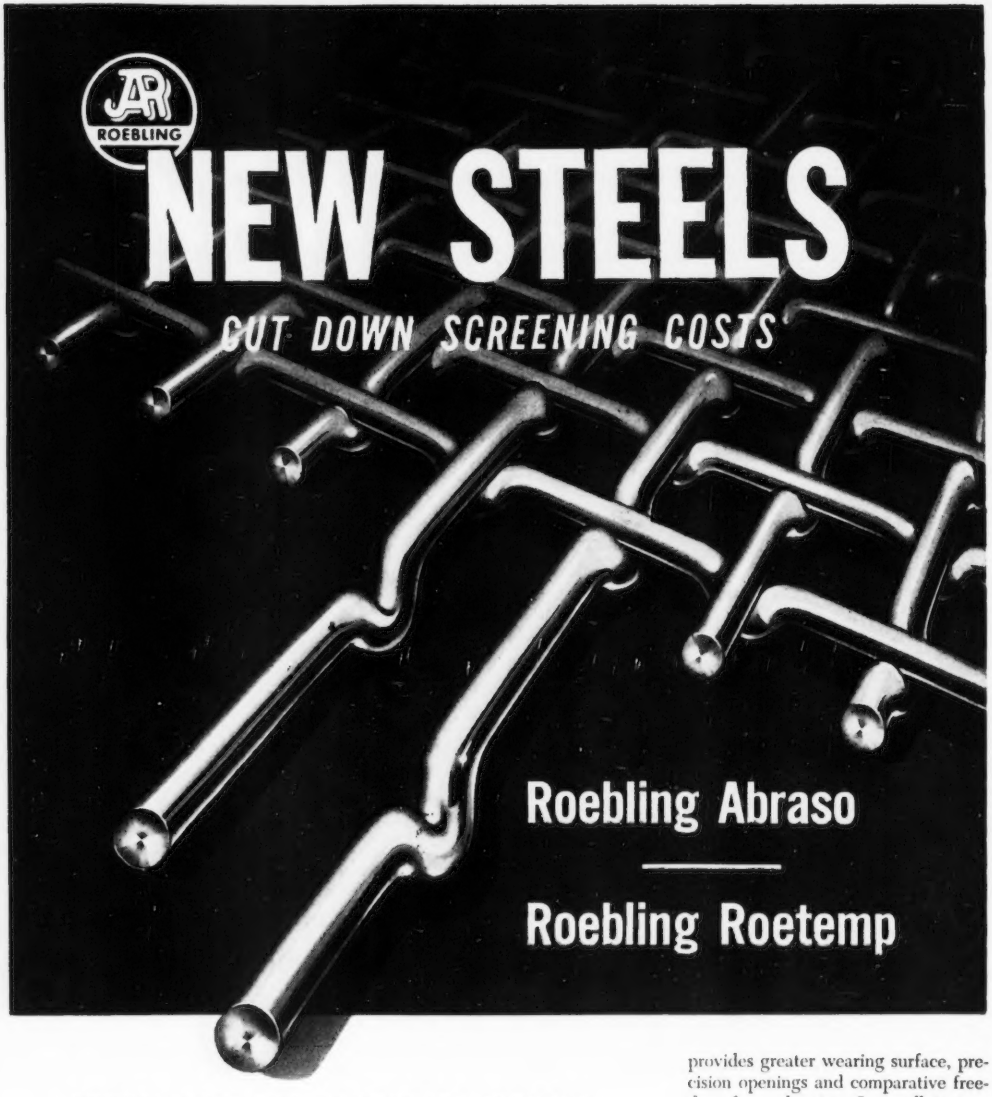
WRITE FOR BULLETINS, OR *Consult a Joy Engineer*

W&D M2572

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO



LONGER LIFE FOR AGGREGATE SCREENS

NOW ROEBLING MAKES two types of steel wire that will save you plenty of screening dollars. They're called "Abraso" and "Roetemp", and they were developed expressly for aggregate screen service. "Abraso" is a special-analysis hard-drawn wire with high resistance to vibration fatigue. "Roetemp" is an oil-tempered wire with top resistance to abrasion. Both wires are exceptionally hard and tough.

Abraso and Roetemp steel wires are woven into Roeton, Roeslot and square mesh screens with ¾ inch space and larger. All these screens are made in Roebling's Roeflat construction which provides greater wearing surface, precision openings and comparative freedom from clogging. In smaller sizes, other constructions can be furnished.

We invite you to try screens woven from Abraso and Roetemp steel wire and to compare them with the screens you are now using. And take the first step towards screening economy *today* —write for Roebling's Aggregate Screens Catalog. John A. Roebling's Sons Company, Trenton 2, New Jersey.

WRITE OR CALL THE ROEBLING FIELD MAN AT YOUR NEAREST ROEBLING OFFICE AND WAREHOUSE

Atlanta, 934 Avon Ave. ★ *Boston*, 51 Sleeper St. ★ *Chicago*, 5525 W. Roosevelt Rd. ★ *Cleveland*, 701 St. Clair Ave., N. E. ★ *Denver*, 1635 17th St. ★ *Houston*, 6216 Navigation Blvd. ★ *Los Angeles*, 216 S. Alameda St. ★ *New York*, 19 Rector St. ★ *Philadelphia*, 12 S. 12th St. ★ *Pittsburgh*, 855 W. North Ave. ★ *Portland, Ore.*, 1032 N. W. 14th Ave. ★ *San Francisco*, 1740 17th St. ★ *Seattle*, 900 First Ave.

ROEBLING

☆ A CENTURY OF CONFIDENCE ☆

HAVE YOU EVER INVESTIGATED THE

NORTHWEST CROWD?

IF you haven't, you will find the Northwest Dual Independent Crowd entirely different from any shovel crowding device you are familiar with.

- It is a simple cable reaving, free from chains and racks and pinions.
- It requires no complications to make it possible to raise or lower the boom.
- It is Dual—Independent plus Automatic.
- It is the only Independent Crowd that utilizes the force in the end of the hoist cable—a force all other Independent Crowds waste.

Here is crowding power that will go through the bank without "stuttering"—without time lost to retracting for a second or third try at filling the dipper. Power like this means money in better output.

You can't afford anything but the best for the heart of your job. Let us help you plan ahead. Send for full details on the many other Northwest advantages. Why not place your order and be sure of a real Rock Shovel in your *Key Spots* for the competitive times ahead?

NORTHWEST
ENGINEERING COMPANY
135 South LaSalle Street
Chicago 3, Illinois

INDEPENDENT CROWD *plus* AUTOMATIC CROWD
FOR GREATER DIGGING POWER
The DUAL CROWD

only the best for the heart of the job
MAKE YOUR KEY MACHINE A REAL ROCK SHOVEL
PROFIT

NORTHWEST

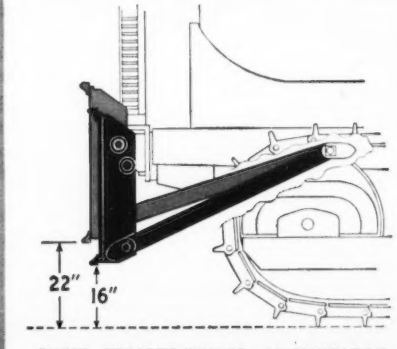
CRAWLER and TRUCK MOUNTED SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

HD-19 TORQUE OUTPUSHES

On Any Stripping Job, Any Time

BIG VOLUME You get heaping loads fast with the BIG HD-19 pushing your scrapers on stripping work. A powerful, 40,000 lb. tractor with long, wide, sure-gripping tracks . . . it gets in there and really "bears down."

What's more — makes contact faster with any make or type scraper combination — no trundling along behind trying to catch up. Hangs on, too, throughout entire loading period — no losing scraper, no sudden, jarring contacts because there's no stopping to shift. Torque Converter automatically synchronizes HD-19's speed with speed of loading unit. And with a final, extra boost, gets scraper off with a flying start. Result — MORE YARDS MOVED AT LESS COST PER YARD.



NEW HEAVY-DUTY, ADJUSTABLE PUSHER PLATE NOW AVAILABLE FOR HD-19. It's bigger, stronger, heavier — weighs 1,600 lbs. It's adjustable — operates at 16" or 22" above ground . . . pushes any make scraper or self-powered hauling unit.

CONVERTER TRACTOR

OUT-'DOZES

Of Year, Under Any Conditions

Shortens **TIME ON EVERY BULLDOZING JOB** The heavier, sure-footed, better-balanced HD-19, working with especially matched bulldozers — plus having the advantages of the Torque Converter drive — assures greater output on bulldozing. Operator can take a deeper cut, roll bigger loads faster . . . and get back for the next pass quicker — has a high reverse of 5.5 m.p.h. Load and terrain and use of throttle govern forward speed . . . and there's no worrying about engine stalling when tractor is overloaded — keeps running, regardless.

And because the HD-19 is on tracks it can be used everywhere on your operation — on wet, sandy or rocky going . . . no job too tough for it to handle. "Seeing is believing" . . . watch it outperform. Contact your Allis-Chalmers dealer.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

ORIGINATOR OF THE TORQUE CONVERTER TRACTOR

THE TIGER BRAND SPECIALIST SAYS—

"It's not use but abuse

USS
AMERICAN
TIGER BRAND
WIRE ROPE
UNITED STATES STEEL

that determines wire rope life"

check your application

"Everything was wrong on this job. When I arrived the superintendent and the operator were having a terrific argument. The 'Super' claimed that the operator was wearing out wire rope twice as fast as anybody else on the job. The operator blamed the machine. I could see that nobody knew the real source of trouble.

"I offered to give them a complete check-up and they both jumped at the chance. It turned out that they were using cast iron sheaves which were too soft. To make it worse, the wire rope was not preformed and tended to twist and squirm as it passed over the sheaves.

"The rope bit into the sheaves and the sheaves got rough and chewed up the rope.

"That's the story. I recommended harder manganese steel sheaves and Excellay Preformed Wire Rope. With the right rope for the job, they ought to get twice the service."

How proper wire rope application saves you money

There is always *one* best type of wire rope for every application and the TIGER BRAND Wire Rope Specialist can help you select the *right* ropes for your particular needs. His job is to make sure that the rope is not overloaded. He checks the sheaves for proper size, wear and alignment. He instructs your operators on proper rope care and does a dozen other things to assure long service life at low unit cost for wire rope.

To help you maintain these operating standards, we have prepared a booklet entitled, "Valuable Facts about the use and care of Wire Rope." Every key man on your operating staff should be supplied with this much needed information.

SEND FOR FREE BOOKLET

American Steel & Wire Company
Rockefeller Building, Dept. C-7
Cleveland 13, Ohio

Gentlemen:

Please send me a copy of your booklet, "Valuable Facts about the use and care of Wire Rope."

Name.....

Company.....

Position.....

Address.....

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

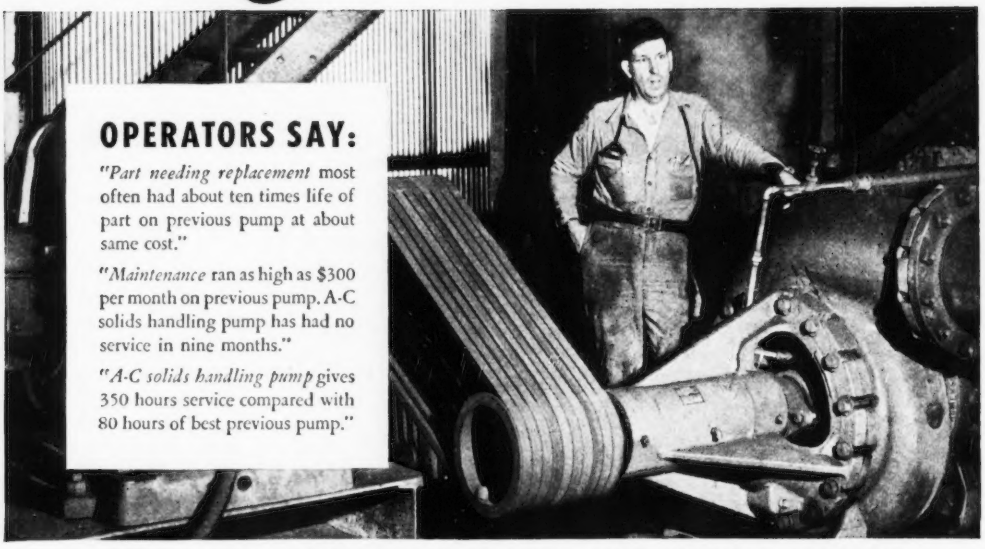
AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

UNITED STATES STEEL

SOLIDS PUMP EXPERIENCE PROVES

Long Parts Life!



OPERATORS SAY:

"Part needing replacement most often had about ten times life of part on previous pump at about same cost."

"Maintenance ran as high as $300 per month on previous pump. A-C solids handling pump has had no service in nine months."

"A-C solids handling pump gives 350 hours service compared with 80 hours of best previous pump."

REPLACE WORN PARTS IN HALF HOUR

YOU CAN GET the two things that metallic and non-metallic material processors want most in solids-handling pumps. Allis-Chalmers solids-handling pumps give you longer life between servicings and they make it easy and economical to replace parts.

Allis-Chalmers solids-handling pumps are designed with extra strong parts, built of *Alliste,* a special abrasion-resistant alloy, and application-engineered by experts with many years of experience in solids-handling pump problems.

SAVES ON REPAIR TIME

When parts must be replaced, as they must in all types of solids handling pumps, the Allis-Chalmers solids handling pump will save you hours of labor, cut down-time to a minimum and lower repair costs.

This pump can be dismantled and reassembled in a half hour without disturbing piping. Parts with varying rates of wear are separated. Only those actually worn are replaced. Three sets of bearings, brackets and shafts cover all pump sizes, reducing parts inventory as much as 2/3.

ALLIS-CHALMERS, 969A SO. 70 ST.
MILWAUKEE, WIS.

GET THE FACTS

Discuss your solids-handling equipment problems with an Allis-Chalmers pump engineer. He can show you dollars and cents savings you can make. Contact your A-C Sales Office today. Or write for Bulletin 6381.

A-2762

ONLY FIVE WEARING PARTS

Shaft sleeve, impeller, casing, two wear plates. All easy to handle and easy to replace. Pump can be dismantled or assembled in a half hour without disturbing piping.

Alliste is an Allis-Chalmers trademark.

ALLIS-CHALMERS

IT TAKES A BAKER FOR THE MAN SIZE JOBS

It is significant that today on the BIG TOUGH JOBS you'll find Baker Bulldozers and the A-C HD-19 in the key spots . . . where the going is toughest, where big yardages must be moved fast and at lowest cost.

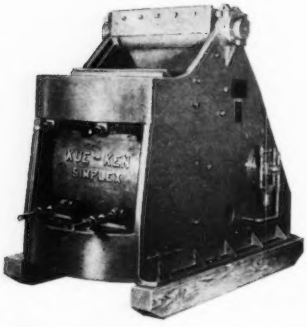
And it's not the color of the paint that makes Baker the favorite — it's the reputation they've been building up among experienced users — for out-dozing anything in the field — for more yardage per pass — for easier operation — for rugged dependability.

These are facts that can be proved in the field, on your job. If you are still using your regular bulldozers, it will pay you to investigate this great, new Baker. See your friendly Baker Allis-Chalmers dealer today.

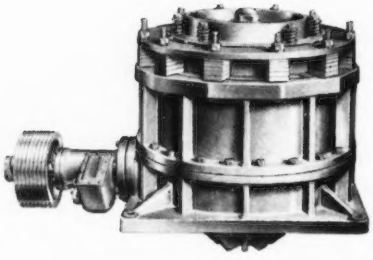
BAKER MFG. CO.
Springfield, Illinois

Only KUE-KEN*

Crushes Without Rubbing



#90—20x36 Kue-Ken Jaw Cruher. Front view showing pump and filter side. 16 other sizes available from 7"x12" to 25"x42".



#36 Kue-Ken Gyratory. Only 45" high. Coarse, medium or fine bowls available. Two sizes available 18 inch and 3 ft.

TWO TYPES

Produce More and Better Crushed Rock at Lower Costs

Kue-Ken JAW CRUSHER

Here is why you profit with Kue-Ken:

HINGE PIN located and SWING JAW designed to "crush without rubbing". Pin extra large. Extra-long bronze bearings sealed in oil.

FRAME has steel side plates welded to box beam strongbacks for maximum strength.

JAW PLATES of manganese steel of various designs for different crushing conditions . . . last 5 to 10 times longer than in ordinary crushers.

ADJUSTMENT of jaw setting quickly, easily made on stationary jaw without changing correct geometric alignment of toggles—an advantage over machines requiring adjustment on swing jaw.

DIAPHRAGM is non-wearing, flexible, seals oil without hampering toggle and jaw movement.

TOGGLES of heat-treated alloy steel operated in sealed oil bath for long life.

PITMAN is simple, strong, weighs 1/10th of ordinary type—always in compression. No caps, bolts, shims needed—permits 50-60% higher speed than old style crushers. Flooded with oil—runs cool at 350 to 425 strokes per min. More capacity, more uniform product.

SHAFT AND BEARINGS: Massive, rigid eccentric shaft in giant self-aligning roller bearings pressed into steel side plates.

LUBRICATION: Completely sealed—dirt stays out, oil stays in. Oil pump constantly floods all mechanism. Pressure switch automatically stops motor if oil pressure drops or in case of overload.

Get Complete Facts—Write Today!
Gyratory Bulletin 604
Jaw Crusher Bulletin 605

*Pronounced Que-Ken U.S. and Foreign Patents Pending.

Kue-Ken GYRATORY

MODERN DESIGN. Extremely low headroom . . . 18" crusher only 30¼" high, 3 ft. size 45" high. Takes choke feed. No restricting spider to reduce flow. No feeder needed.

PROTECTION. Kue-Ken-designed moulded, flexible, oil-resistant seal completely protects mechanism from dirt and grit.

SHAFTS and BEARINGS. Larger than in any other gyratory—18" crusher has 7" shaft, 3 ft. size a 12" shaft. Provides greater bearing area for cool running, longer life. Upper bearings are close under crushing head, reducing overhang and placing load more squarely on bearings.

LUBRICATION. Positive-type pump geared to shaft is submerged in oil—cannot lose its prime. Provides filtered "flood" lubrication to all parts. Automatic pressure switch protects against lubrication failure.

OVERLOAD RELEASE. Simple, automatic safety device protects crusher against tramp iron and overload. Easily set for any desired load.

CAST STEEL FRAME. Extra thick with tremendous strength to match the giant shafts, yet more compact and stronger than ordinary crushers.

FAST ADJUSTMENT. Positive, simple adjustment for different sizes of product . . . average operator does job in about five minutes.

KEU-KEN is the only gyratory that operates on the long-proved principle of "crushing without rubbing". This means more capacity with less power, less wear and lower upkeep.

Exclusive manufacturer for Eastern U. S., Canada and Puerto Rico: Pennsylvania Crusher Co., Broad and Arch Sts., Phila., Pa. Licensed manufacturer for Australia: Tutt Bryant, Ltd., South St., Rydalmere, NSW.

STRAUB MFG. CO.

516 CHESTNUT STREET • OAKLAND 20, CALIFORNIA

Kue-Ken Balanced Crushers	Rib Cone Ball Mills	Overflow Classifiers
Kue-Ken Simplex Crushers	Concentrating Tables	Feeders
Kue-Ken Gyratory Crushers	Overhead Eccentric Crushers	Screenwheel Classifiers

Daily double for pit and quarry work

HERE's the tire that pays off two ways on pit and quarry hauling everywhere — Goodyear's new, improved Road Lug. This remarkable double-duty work tire is specially designed for maximum tire performance both OFF *and* ON the road.

For rugged traction OFF the road— the Road Lug has big husky lugs, designed to grip on dirt, gravel and other off-the-road surfaces.

For smooth rolling ON paved roads — the lugs are joined at the center for long even wear.

Other outstanding features of this dual-purpose tire are: extra-strong carcass and undertread — tapered grooves between the lugs to prevent the picking up and holding of stones — wider-spaced, deeper lug bars. No doubt about it, Goodyear's new, improved Road Lug is your best bet for all-purpose hauling. Remember, always BUY and SPECIFY Goodyear —*it pays!*

The Super-Stamina Tire for OFF-THE-ROAD Hauling

THE HARD ROCK LUG

This extra-husky tire is best for all OFF-THE-ROAD tire-ripping, tire-bruising jobs. Ask your Goodyear dealer about it now!

Road Lug—T. M. The Goodyear Tire & Rubber Company

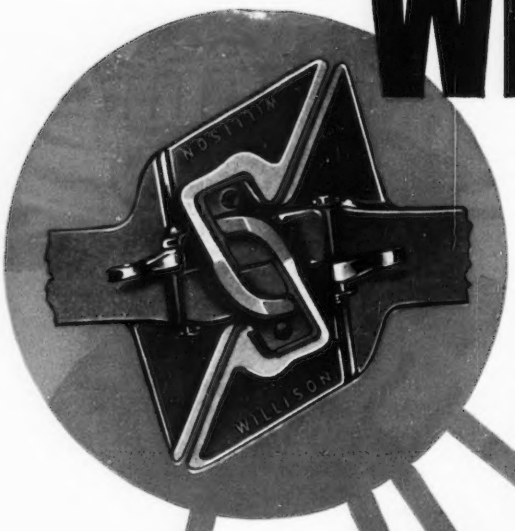
GOODYEAR

WILLISON

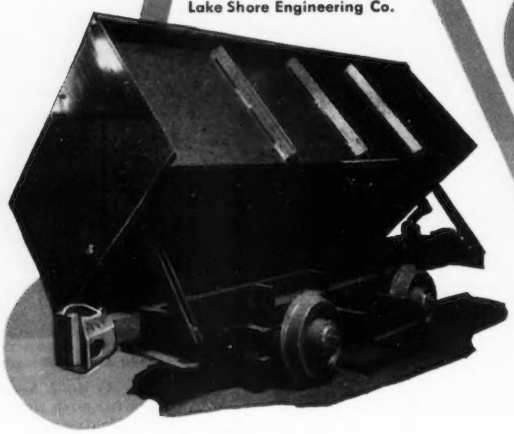
for Lower

Here is why cars equipped with Willison Automatic Couplers will simplify your haulage problems and save you money.

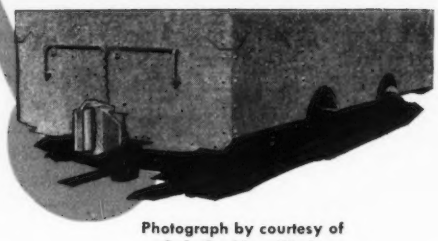
1. The simple, rugged design of Willison Automatic Couplers keeps maintenance costs at a minimum. The coupler consists of essentially two parts: the head and the lock. There is no pivoted hook or knuckle—stresses are received by the coupler body



Photograph by courtesy of
Easton Car and Construction Co.



Photograph by courtesy of
Lake Shore Engineering Co.



Photograph by courtesy of
C. S. Card Iron Works

NATIONAL MALLEABLE AND
WILLISON AUTOMATIC COUPLERS • NACO STEEL WHEELS • NACO

automatic COUPLERS

Haulage Costs and Greater Safety

without the interposition of a single movable part. Great strength per unit weight is inherent in this basic design.

2. Willison Automatic Couplers provide the maximum in safety. No manual assistance is needed for coupling. Workmen needn't go between cars to uncouple them.

3. The wide gathering range and identical contours of Willison Automatic Couplers facilitate car handling. You're not on a "one way street" with Willisons —all couplers are alike. Locomotives, mantrip, service cars and other equipment never need to be reversed in order to couple. This saves time—and time costs money.

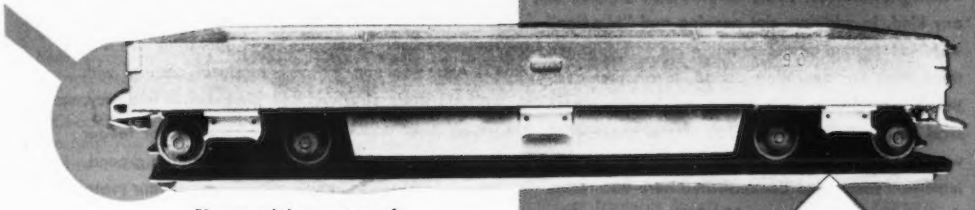
4. Because Willison Automatic Couplers eliminate damaging slack, they permit higher speed haulage with maximum stability and greater protection to rolling stock. The resulting smoother train operation reduces surging, spilling, and danger of derailment.

5. The versatility of Willison Automatic Couplers has made possible a large variety of applications. Cars of all sizes in nearly every type of service have been equipped with Willisons. Specify Willisons on your equipment—there's a suitable application for every car and job.

NATIONAL MALLEABLE AND STEEL CASTINGS COMPANY
Cleveland, Ohio

SOME OF THE MANY USERS OF WILLISON COUPLERS

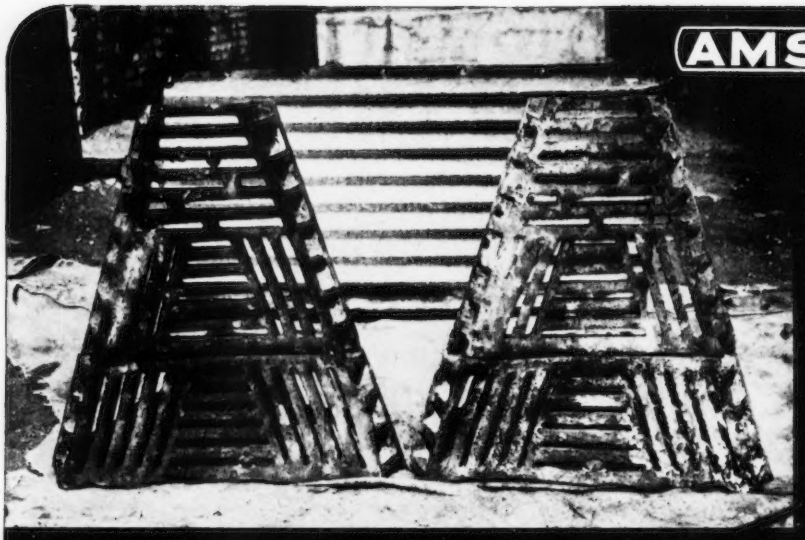
Allegheny Pittsburgh Coal Co.
Allied Chemical & Dye Corp.
Aluminum Company of America
Ashcroft Coal Company
Australian Iron & Steel Ltd. (Australia)
Aweba State Mine (Australia)
Bethlehem Steel Company, Inc.
Bethlehem Pacific Coast Steel Corporation
Black Rock Coal Corp.
Buckeye Coal Co.
Calumet & Hecla Consolidated Copper Co.
Christopher Coal Co.
Cleveland Cliffs Iron Co.
Colorado Fuel and Iron Co.
Consolidation Coal Co.
Crowpen Collieries (Great Britain)
Drava Corporation
Duquesne Light Co.
Eastern Gas and Fuel Associates
Hanna Coal Co.
H. C. Frick Coke Co.
Hebburn Colliery (Australia)
Jamison Coal & Coke Co.
Inland Steel Co.
International Salt Co.
Lake Shore Mines, Ltd. (Canada)
Lancaster Collieries (Great Britain)
Londonderry Collieries (Great Britain)
Lonsley Collieries (Great Britain)
Lysaght Steel Works (Great Britain)
Mather Collieries
Mathieson Alkali Works, Inc.
New Jersey Zinc Co.
North Range Mining Co.
Oliver Iron Mining Co.
Peck's Run Coal Co.
Pickands-Mather & Co.
Pioneer Coal Co.
Pittsburgh Coal Co.
Potash Company of America
Purton Mining Co.
Pursglove Coal Co.
Republic Steel Corp.
Simpson Creek Collieries Co.
South Union Coal Co.
Steel Company of Wales (Great Britain)
Tennessee Coal, Iron, & Railroad Company
Tennessee Copper Co.
Trotter Coal Co.
U. S. Coal and Coke Co.
Vaal Reefs and Saint Helena Mines (Union of South Africa)
Weirton Coal Co.
Westmoreland Coal Co.



Photograph by courtesy of Carnegie-Illinois Steel Corp.

NATIONAL *Products* **FOR TRANSPORTATION AND INDUSTRY**

STEEL CASTINGS CO.
STEEL LINKS AND SWIVEL HITCHINGS



Unretouched illustration of Amsco special manganese steel grates . . . after handling 193,797 tons of gold bearing quartz rock in ball mill.

BALL MILL GRATES *after 193,797 tons*

Where operations involve impact and abrasion, you will find Brake Shoe facilities a sure source for wearing parts that will stand up longer . . . to give you important reductions in operation cost.

A case in point is the grates used in ball mills. In one application Amsco special manganese steel grates handled a total of 193,797 tons of gold bearing quartz rock . . . without requiring repair of any kind. In addition, slot peening and "blinding" were so little that an acceptable grind was obtained throughout the operating period. In another comparable installation, with Amsco special manganese steel grates, a total of 176,360 tons of quartz rock was handled at a cost of $0.00369 per ton. An important factor was demonstrated here also: while the previous grates gave a 136,923 ton service life, repair was required during this period totalling 29¼ hours; this lost time cost an estimated $200.00 per hour in lost tonnage.

The reason for such outstanding performance with Amsco parts is threefold: (1) Brake Shoe metallurgical research in manganese steel and other alloys makes possible the selection of the best steel or iron to cope with the specific job conditions; (2) Amsco application experience supplementing that of the mill operator often results in design improvements that alone can greatly lengthen operating life; and (3) Amsco foundry practice produces castings with uniform grain structure and dimensional accuracy.

If you think that your mill grates, liners or feeder lips are costing you too much per ton of ore ground, we may be able to help in the solution of your problem. All uses for Amsco alloy steels in metal mines and mills are described in Bulletin 743-M.

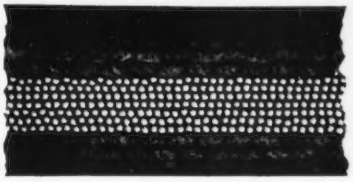
AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo.
Offices in principal cities. In Canada: Joliette Steel Limited, Joliette, Que.

Du Pont "Cordura" Rayon packs strength into a CONVEYOR BELT CARCASS

Cross-section of belt reinforced with 7 plies of "Cordura." This belt is designed to lift 1000 tons of overburden per hour up 15° slope over 1100-foot centers. Design tension 900 pounds per inch of width. Below is magnified section.



Engineered to provide high strength at low cost, Du Pont "Cordura" Rayon can be helpful to conveyor belt users and manufacturers in many ways.

Because of the great strength of "Cordura" Rayon, a conveyor belt with a carcass of this material can be made much lighter, without sacrificing load-carrying ability. And the same high tensile strength also meets the need for long belts that eliminate costly transfer points.

"Cordura" rayon is now widely used to make V-belts stronger, and more efficient . . . to make heavy-duty tires with a thinner, tougher carcass . . . to increase the bursting strength of hose—or make it much lighter.

Check the various ways in which "Cordura" rayon can help you get improved conveyor belt service. And next time you order a conveyor belt, ask your supplier for a carcass made with Du Pont "Cordura" High Tenacity Rayon. In the meantime, write Du Pont for further information about the use of "Cordura" in conveyor belts.

Address Room 4529, Rayon Division, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

Look to "Cordura" Rayon for these conveyor belt advantages:

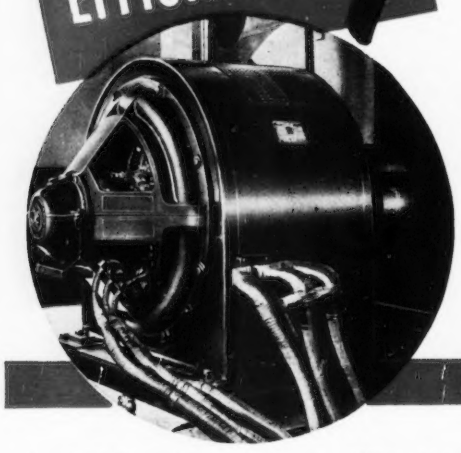
- ★ *Greater tensile strength*
- ★ *Longer life*
- ★ *Heavier loads*
- ★ *Improved troughability*
- ★ *Longer lifts with fewer transfer points*
- ★ *Lighter belts that are easier to set up*
- ★ *Resistance to flexing*
- ★ *Resistance to loading impacts*
- ★ *Reduced operating power expense*

DU PONT "CORDURA" HIGH TENACITY RAYON

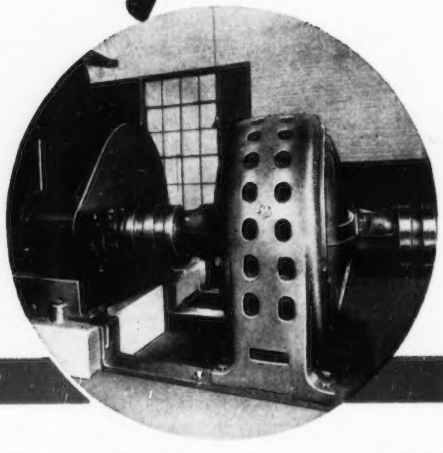
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

For RAYON . . . for NYLON . . . for FIBERS to come . . . look to DU PONT

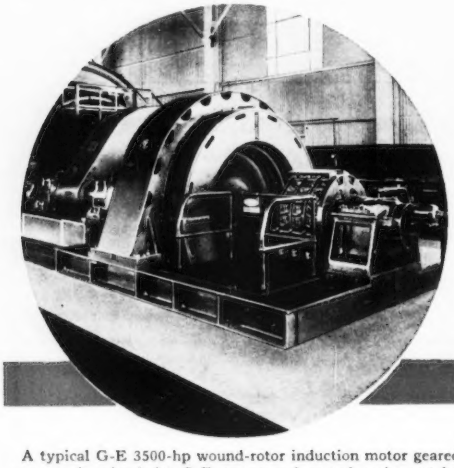
SIMPLICITY... ECONOMY... EFFICIENCY... you get



A typical G-E wound-rotor induction motor, 1000 hp, driving an ore hoist at a lead mine. G-E induction motors, ranging in capacities from 50 to 3500 hp, provide the simplest, least expensive method of obtaining the advantages of electric drive for mine hoists.



This 600-hp G-E induction motor is one of 16 identical units in a large Eastern mining operation. To meet specific duty cycles, G-E mine-hoist control uses the "definite-time" accelerating relay system that requires fewer interlocks, employs simpler panel wiring, and affords longer relay life.



A typical G-E 3500-hp wound-rotor induction motor geared to a main mine hoist. G-E motors and control equipment for mine hoists, designed and built for rugged service, have been on the job for many years in hundreds of mines throughout the country.

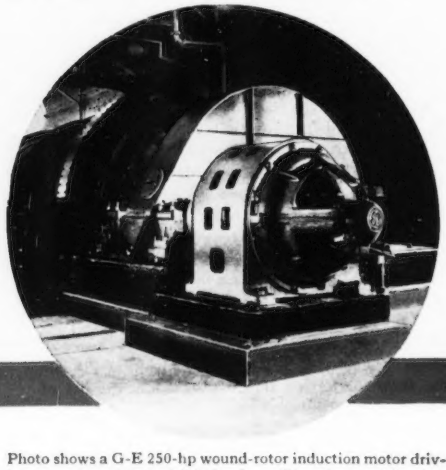


Photo shows a G-E 250-hp wound-rotor induction motor driving a man-and-material hoist in a Wyoming metal mine. G-E mine-hoist induction motors are low in upkeep cost, and require little or no maintenance attention. They need only routine lubrication and occasional brush renewal.

all three

with a G-E INDUCTION MOTOR Mine-Hoist Drive!

Here's your reliable, low-cost way to high-tonnage ore hoisting! With a General Electric a-c mine-hoist drive, you combine the basic advantages of simple operation, low first cost and upkeep, and high efficiency.

In the G-E wound-rotor induction motors used for this service, the stator and rotor windings—specially insulated and securely braced—are ample for full "plugging" operation. All hoist-motor rotors are also strongly banded in place to withstand frequent reversing and above-synchronism operation.

SIMPLE CONTROL. Speed regulation is simple, and controlled through primary and secondary contactors by a master switch mounted at the operator's platform. Seven to ten successive speed steps are provided, from standstill to full-speed running position. Efficient, adjustable-speed control of overhauling loads is obtainable, where indicated, by dynamic braking, in which d-c excitation is applied to the motor stator windings.

G-E hoist control is designed to give maximum protection to machines and personnel in the event of abnormal operating conditions.

More than 700 performance-proved G-E drives—both a-c and d-c—are now helping mines throughout the country to step up production, and reduce hoisting costs. Whether you're installing a new hoist or modernizing an existing one, an experienced G-E mining specialist will gladly size up your problem, and help you meet it economically. Call him at your nearest G-E office. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

G-E enclosed mine-hoist primary control panel includes oil circuit breakers, air-break reversing contactors, line disconnects, and current and potential transformers.

Metal enclosures protect operating personnel, guard equipment against dirt and dust, and reduce maintenance and upkeep costs. Unit is factory-wired and assembled for quick, easy installation. Front view is shown above, and rear view at left.

MOTORS AND CONTROL
—to help the mining industry cut costs electrically!

GENERAL ELECTRIC

660-16

As mining looks to the future...

GARDNER-DENVER

keeps the pace!

Wherever the mines of tomorrow are located — whatever the mining methods — you'll find Gardner-Denver fine quality mining tools on the job. For throughout the mining world, Gardner-Denver equipment is famous for that extra measure of performance that often makes the difference between waste rock and pay dirt.

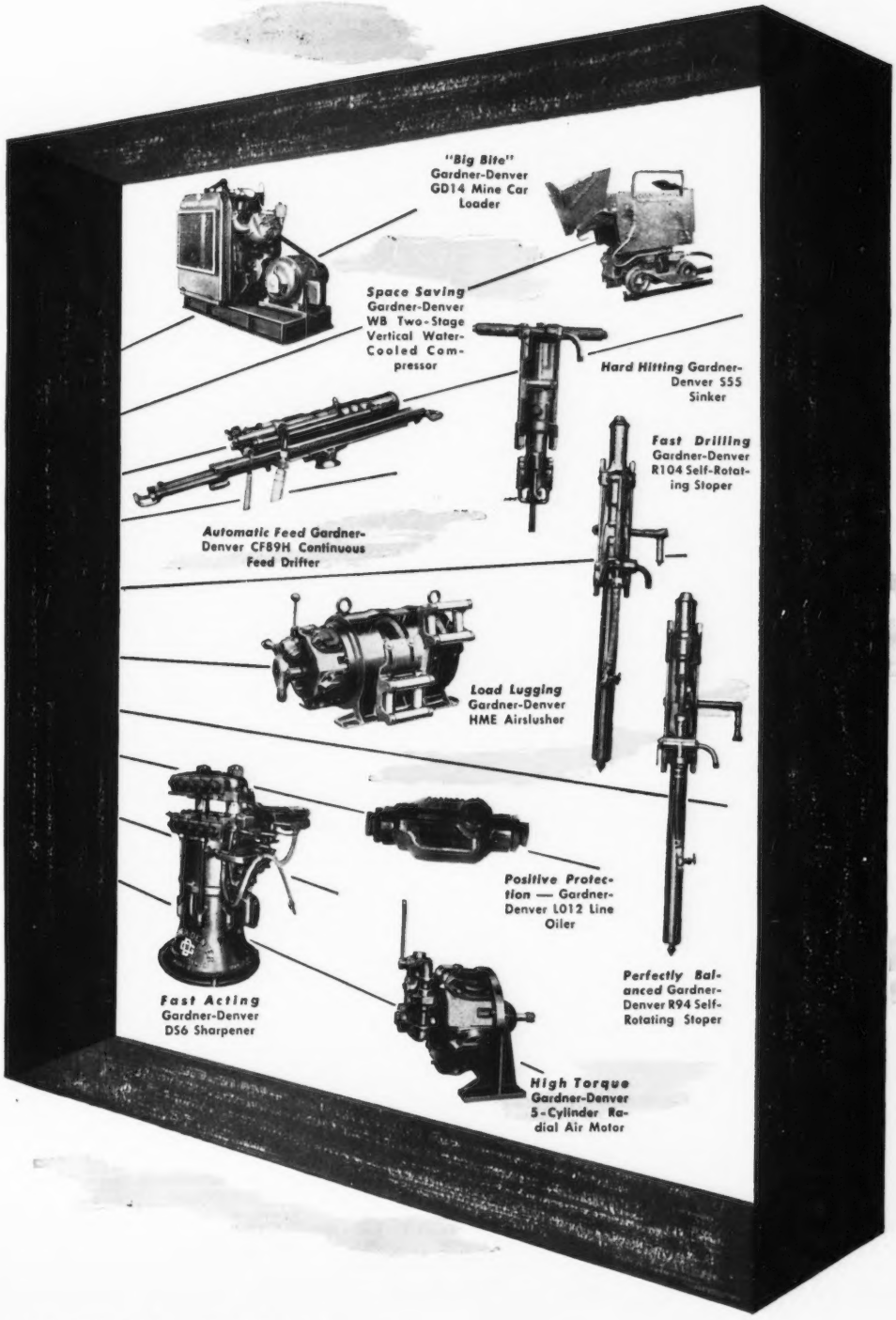
Gardner-Denver — familiar with problems of the constantly expanding mining industry — keeps the pace with new and improved machines that help you increase mining efficiency.

For further information on the popular Gardner-Denver models shown here, write us today!

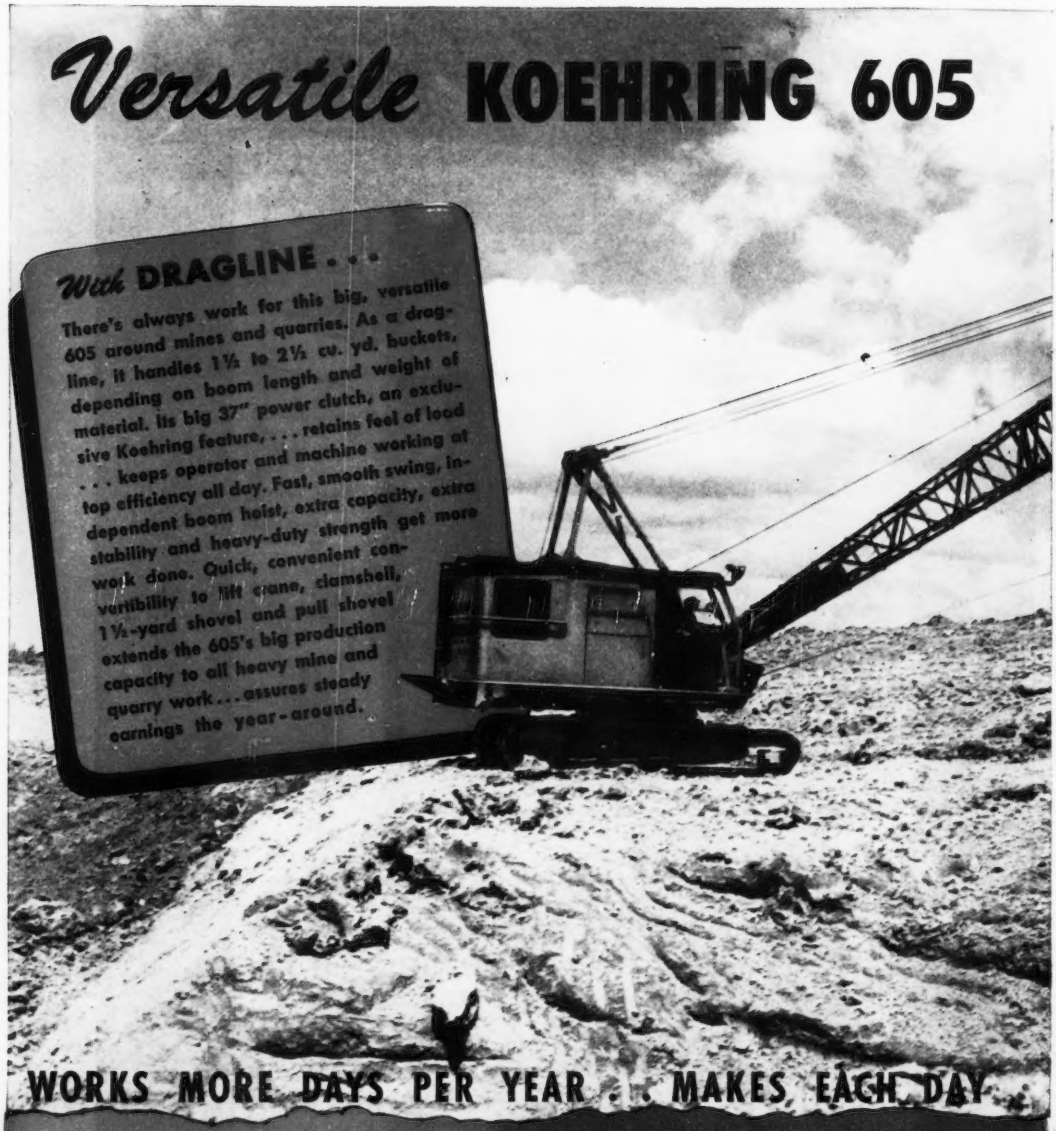
GARDNER-DENVER Since 1859

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada) Ltd., Toronto, Ontario


"Big Bite" Gardner-Denver GD14 Mine Car Loader
Space Saving Gardner-Denver WB Two-Stage Vertical Water-Cooled Compressor
Hard Hitting Gardner-Denver S55 Sinker
Fast Drilling Gardner-Denver R104 Self-Rotating Stoper
Automatic Feed Gardner-Denver CF89H Continuous Feed Drifter
Load Lugging Gardner-Denver HME Airslusher
Positive Protection — Gardner-Denver L012 Line Oiler
Perfectly Balanced Gardner-Denver R94 Self-Rotating Stoper
Fast Acting Gardner-Denver DS6 Sharpener
High Torque Gardner-Denver 5-Cylinder Radial Air Motor

Versatile KOEHRING 605


With DRAGLINE . . .
There's always work for this big, versatile 605 around mines and quarries. As a dragline, it handles 1½ to 2½ cu. yd. buckets, depending on boom length and weight of material. Its big 37" power clutch, an exclusive Koehring feature, . . . retains feel of load . . . keeps operator and machine working at top efficiency all day. Fast, smooth swing, independent boom hoist, extra capacity, extra stability and heavy-duty strength get more work done. Quick, convenient convertibility to lift crane, clamshell, 1½-yard shovel and pull shovel extends the 605's big production capacity to all heavy mine and quarry work . . . assures steady earnings the year-around.

WORKS MORE DAYS PER YEAR . . . MAKES EACH DAY . . .

Here's why . . .

- Quick convertibility to dragline, lift crane, clamshell, shovel and pull shovel means more work days, no "off-season" hold-ups.
- Big 37" power clutch cuts normal lever pull 90% . . . retains load feel . . . cuts operator fatigue, steps up output with every attachment.
- Swing is smooth, because light spiders inside band clutches, not heavy drums, are accelerated . . . rotate cool-running finned drums.

KOEHRING COMPANY

Milwaukee 10, Wisconsin
Subsidiaries: JOHNSON
PARSONS • KWIK-MIX

KEEPS BUSY YEAR-AROUND

MORE PRODUCTIVE . . .

- Moves, steers, stops, holds with positive traction-brake steering. Steers with turntable in any position. Result: extra maneuverability.
- High-quality, heavy-duty construction . . . simple, accessible machinery . . . assure steady production daily, on every application.

With 1¼-YD. SHOVEL or PULL SHOVEL . . .
For your heaviest excavation, 605 with 1¼-yard dipper, has rugged rock boom of rigid welded box design, mounted on massive, shock-absorbing base . . . withstands torsional twists and strains of heavy-duty digging. Can also be used with 1½-yard pull shovel during "off-season" for mine drainage . . . digs ditches 23' below tracks . . . up to 54" wide bite . . . 40½' digging reach for wide work range.

With LIFT CRANE OR CLAMSHELL . . .
When not in use as an excavator, the big 605 with crane attachment handles heavy lifts up to 30 tons. Power-boom lowering available. Koehring 605 also provides you with high-speed clamshell operation for stockpiling and other bulk materials handling. There's no end to the jobs this all-modern, fully-convertible excavator can handle around your property. Speed in every operation gets work done.

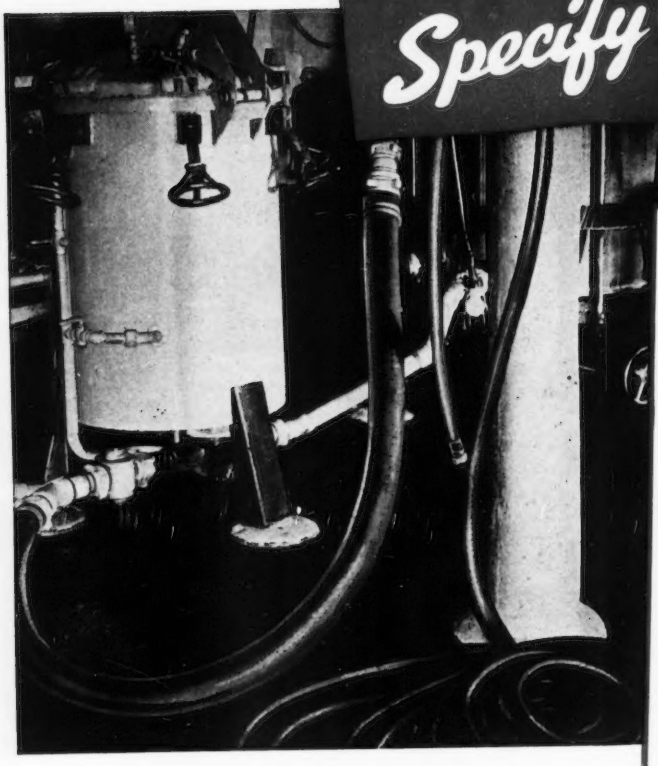
DUMPTORS®. For balanced, high-production excavating and hauling, team up Koehring excavators with 6-yard Dumptors. You gain 3 speeds forward and reverse for fast, no-turn shuttle haul . . . 6 h.p. per ton of gross vehicle weight for rough, off-road hauling . . . plenty of power to pull up grades to 24% fully loaded. Ask, too, about bigger, new 12-yard Koehring Rocktor® for hauls over 3,000 yards.

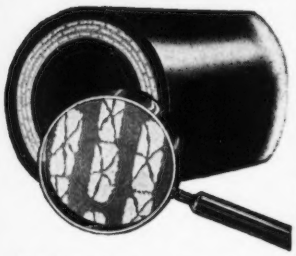
*Trademark Reg. U. S. Pat. Off. K826

KOEHRING HEAVY DUTY

Koehring Excavators are available in a complete range of sizes: ½-yd. 205, ¾-yd. 304, 1½-yd. 605, and new 2½-yd. 1005. For complete facts see your Koehring distributor . . . or write to him for bulletins.

Specify Thermoid





The Thermoid Impregnation Process insures a deeper penetration of rubber between the threads of the yarn, which encases each individual strand with protective rubber. The rubber acts as a sheath between the strands and prevents the destructive abrasive action as the product is flexed in use. To obtain the required rubber penetration, the twist of the yarn must be to exact specifications. With the yarn twisted too tightly, proper penetration of the rubber compound is impossible. This condition produces abrasion, causing premature failure. On the other hand, if the yarn is twisted too loosely, the product lacks tensile strength. Thermoid has discovered the optimum twist of the yarn which assures maximum rubber penetration and greatest strength. The development of Thermoid Impregnation Process is another step forward in Thermoid's planned program of product improvement, assuring maximum service and lower operating costs to industry through the use of Thermoid Industrial Rubber Products.

Versicon Hose Cuts Costs

Now available . . . a multi-purpose hose designed for superior performance with virtually any liquid or gas . . . Thermoid Versicon Hose. It is made with neoprene tube and oil-resistant cover—with high tensile rayon cords to insure maximum strength, light-weight and flexibility.

Versicon, another of the famous quality rubber products made available to industry through Thermoid research, is the answer to a long felt need. Now your nearest Thermoid distributors can supply you with *one hose* for your requirements. Now you can cut your costs and reduce inventory. Versicon eliminates the need for special hose . . . Versicon *is* the special hose. Available from 3/16" to 2½" for use with air, water, oil, gases and virtually all fluids in lengths from 50' to 500' depending on size.

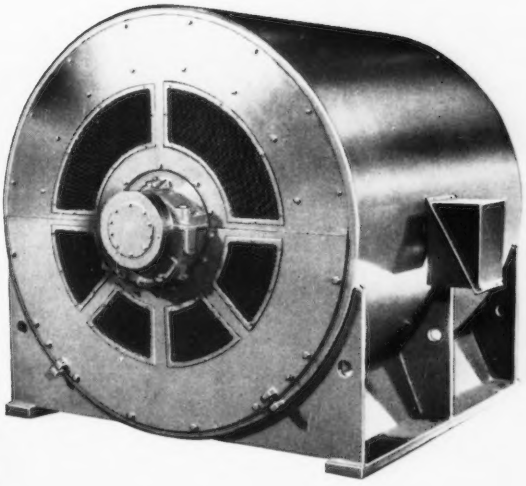
It will pay you to ***Specify*** Thermoid!

Thermoid Quality Products: Transmission Belting • F.H.P. and Multiple V-Belts • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Molded Products • Industrial Brake Linings and Friction Materials.

Thermoid Company

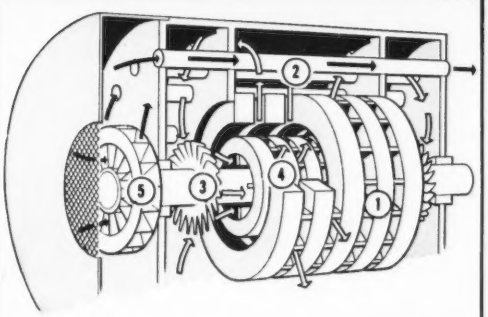
Main Offices and Factory • Trenton, N. J., U. S. A.
Western Offices and Factory • Nephi, Utah, U.S.A.
Industrial Rubber Products • Friction Materials • Oil Field Products

TUBE-TYPE
TOTALLY-ENCLOSED FAN-COOLED MOTORS!



INSTALL INDOORS or OUT!

How Tube Cooling Works



Stator core (1) is surrounded by tubes (2). Internal fans (3) circulate air through ducts (4) in rotor and stator and around tubes, transferring heat to tubes. External fan (5) drives outside air through tubes, removing heat and keeping tubes clean. All electrical parts are enclosed. Dirt cannot enter.

- **Dirt-proof and corrosion-resistant**
- **Heat exchanger is practically *self-cleaning***
- **Simple self-contained cooling system—sizes from 75 to several thousand horsepower**

WHEREVER DUST, DIRT, fly ash, rain and snow, smoke, or corroding fumes keep motor maintenance costs high, this Allis-Chalmers tube-type motor will cut maintenance sharply.

All electrical parts—including stator core—are enclosed. Simple heat transfer system keeps temperatures well within rated limits. Cleaning is rarely needed because air passages are unrestricted. Air flow through the straight tubes removes foreign matter.

Important savings have been proved in three years of field operation. Sizes from 75 hp and up. Also explosion-proof designs. For complete information, outline your requirements to your A-C Sales Office, or write for Bulletins 05B7150 and 51R7149.

A-2610

ALLIS-CHALMERS, 969A SO. 70 ST.
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ALLIS-CHALMERS

"MINING LOOKS TO THE FUTURE"

thru the Eyes of the Metallurgist

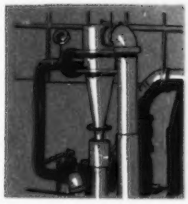
Millions of tons of low-grade ores are workable today because of ore-dressing research and testing done three, five, yes ten or more years ago. Vast treasure houses of minerals will be unlocked by recently developed reagents and processes, or by those yet to be discovered or fully exploited. Of this, there can be no question.

The past presages the future. Consider just one example — the beneficiation of fine iron ore:

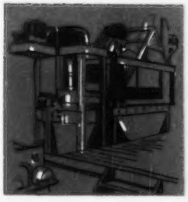
Research on this problem started prewar thru work on the use of "mahogany soaps" on copper ores. Testing in the Cyanamid Mineral Dressing Laboratory indicated that processes using these types of compounds gave excellent results in the beneficiation of iron minerals. Hundreds of tests, run in co-operation with prominent iron producers, confirmed laboratory results. Successful operation of a 10-ton per hour pilot plant for two seasons has proved the commercial applicability of the process.

Simultaneously, progress has been made in the use of the Dutch State Mines Cyclone Separator to treat fine ore in the size range below Heavy-Media Separation. Pilot plant tests on a large number of fine ores have produced concentrates of excellent grade and with high recovery. Testing and application work are being vigorously prosecuted, both in the Cyanamid Mineral Dressing Laboratory and in the field.

AMERICAN Cyanamid COMPANY



The ultimate economic flow scheme for any one mine may as yet be undetermined. But certain it is that long before high-grade ores run out, the beneficiation and use of low-grade and fine iron ore will be completely practical.



On other beneficiation problems intensive work goes steadily forward in the Cyanamid Mineral Dressing Laboratory . . . problems such as the flotation of certain oxidized Zinc and Copper minerals; the selective flotation of Cassiterite; the economic treatment of Zinc Carbonate, etc., etc.

In Cyanamid Mineral Dressing Laboratory thousands of new and old chemicals are tested; an infinite number of reagent combinations and processes explored. Though only a few significant advances may result from a tremendous amount of technical work, cumulative progress has produced an ever-increasing selection of reagents and processes for treating refractory and lower-grade feeds.

These include such standbys as Aerofloat* Nos. 15, 25, 31, 33, 208, 238, 241, 242, Sodium Aerofloat and Sodium Aerofloat "B." Other developments are Cyanamid 300 Series Xanthates; 400 Series Promoters for Oxidized Non-Ferrous Ores; 500 Series Selective Sulphide Depressants; 600 Series Depressants; 700 Series Fatty Acid Reagents as well as 800 Series Promoters for Oxide Minerals.

Paralleling reagent development has been the application of Heavy-Media Separation and the Dutch State Mines Cyclone Separator, alone and as an adjunct to chemical beneficiation, (1) to make directly-marketable concentrates, (2) to preconcentrate ores and waste previously considered too low-grade to warrant treatment, or to reduce tonnage going to more costly milling operations, (3) to capitalize on mechanization by minimizing selective mining.

Yes, thru the eyes of the metallurgist, MINING LOOKS TO THE FUTURE with assurance that it has and will continue to have the reagents and processes to solve any foreseeable treatment problem. In this Cyanamid Mineral Dressing Laboratory and Cyanamid Field Engineers will continue to work with mill metallurgists the world over to obtain highest recovery at lowest cost from the ore bodies of today . . . and tomorrow.

**Aerofloat is a registered trademark of American Cyanamid Company applied to flotation reagents of its manufacture.*

MINERAL DRESSING DIVISION

30 ROCKEFELLER PLAZA NEW YORK 20, NEW YORK

make it a

One-Piece Pipe Line

with SILBRAZ* joints

Silbraz joints, made with Walseal* valves, fittings and flanges, actually make a "one-piece pipe line" of brass, copper, or copper-nickel I.P.S. pipe or tubing . . . leaky joints are completely eliminated, and maintenance costs are reduced to the minimum.

A Silbraz joint is *silver-brazed* — not soldered. This modern pipe joint will not creep or pull apart under any condition which the pipe itself can withstand . . . vibration or corrosion will not affect it. A Silbraz joint is designed to have a tensile strength equal to about three times standard weight brass pipe, and the pipe will fail before the joint will pull apart.

For full information about Silbraz joints made with Walseal valves, fittings and flanges, see your nearby Walworth distributor, or write for Circular 84.

*Patented — Reg. U. S. Patent Office

SEE OUR CATALOG IN SWEET'S

Make it a "one-piece pipe line" with Walseal

WALWORTH

valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

COMPLETE SERVICE

CHRISTENSEN

Diamond Bits
Supplies and Machines For
The Drilling Industry

Christensen Diamond Core Bits provide the industry with uniformly high quality, dependable service for every need. Christensen designs and produces diamond core bits, concave bits, pilot bits, casing shoes, casing bits and reaming shells.

The same fidelity of design, engineering and manufacture that characterizes Christensen bits goes into the production of drill rod, core barrels and a complete supply line for the driller.

Christensen surface drills, either hydraulic or screw feed, gasoline or air powered. Skid mounted for easy moving. Capacities up to 2000 feet of hole. Underground air drills for exploratory, blast hole and all underground drilling needs. Capacities up to 1000 feet of hole.

Compact • Sturdy • Efficient

LESS COST PER FOOT CHRISTENSEN DIAMOND PRODUCTS

Less Cost Per Foot

CHRISTENSEN DIAMOND PRODUCTS COMPANY

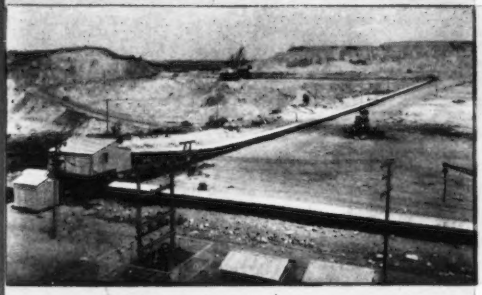
1975 SOUTH 2ND WEST • PHONE 6-8738 • SALT LAKE CITY, UTAH

This photo shows the stacker and trailing conveyor designed to reach an ultimate length of 2,500 feet when on the horizontal as dump progresses. The trailing truss section is about 100 feet long and contains the power and propelling mechanism to pull trailing conveyor forward enough to install additional sections as needed.

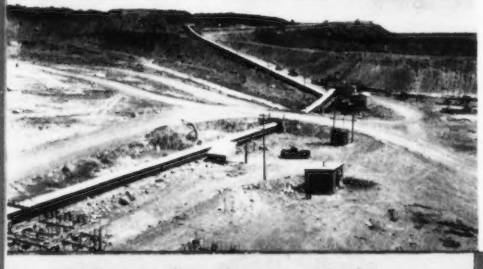
● Jeffrey presents a unique trailing conveyor and stacker system for handling and stacking overburden on the Mesabi Iron Range. Starting with the trailing truss section, Jeffrey furnished the 245 foot long stacker complete, including all idlers, machinery parts, propelling mechanism and drives. In fact, the stacker was completely designed and built by Jeffrey.

In the loading hopper Jeffrey furnished the two 60″ wide belt conveyors and machinery parts. Also the small transfer hopper complete including all steel work, idlers and propelling mechanism. From the loading hopper back to the stacker trailing truss section, a total length of 9,831 lineal feet, all troughing and return idlers, pulleys, bearings and shafting for the 48″ wide main conveyors were furnished by Jeffrey.

When it comes to material handling jobs, large or small, you can depend upon Jeffrey equipment. Jeffrey has the engineering experience—the engineering staff—and the facilities to help you. Consult Jeffrey on your material handling jobs.



General view of loading arrangement and conveyor for moving over-burden from loading hopper. The drag line and loading hopper are shown at the top, center.

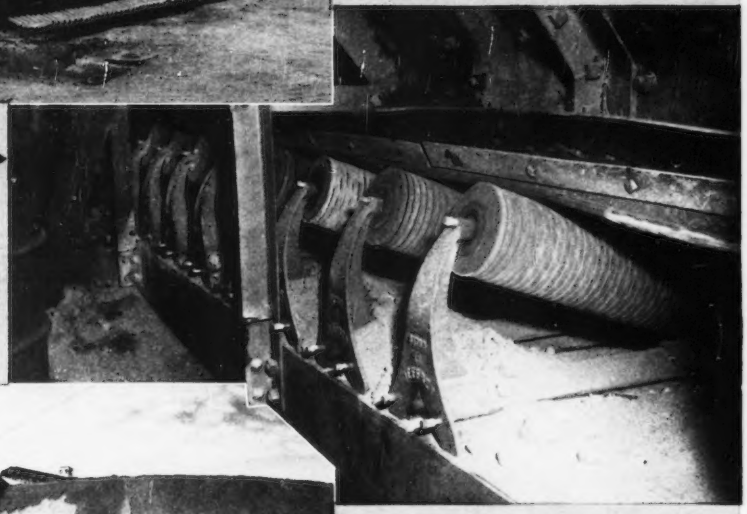


This view shows the conveyor leading up to the stacker. From the photo above and this one you can get a fairly good idea of the size of this project. The total conveyor length is 9,831 lineal feet.

Conveyors
HANDLE OVERBURDEN ON MESABI IRON RANGE

This photo will give you an excellent idea of the size of the conveying job on this installation. It shows a stack of Jeffrey troughing idlers waiting for installation. These are only a part of the hundreds of Jeffrey idlers required for this unique conveyor set-up.

Showing Jeffrey rubber-covered idlers installed beneath the hopper of the traveling screening plant. These idlers take the brunt of the punishment caused by the large pieces of rock that come through the screen onto the 60" belt—save wear and tear on the belt.



Here is a view of the stacker discharging onto fill. Note the height of this fill and you will realize the vast amount of material handled and the flexibility of the equipment used on the job. Jeffrey's experience in designing and building stackers and conveying equipment is evidenced in the accompanying views of this Mesabi Iron Range installation.

THE JEFFREY MANUFACTURING COMPANY

974-99 NORTH FOURTH STREET, COLUMBUS 16, OHIO

Baltimore 1 · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 7 · Cleveland 15 · Denver 2 · Detroit 32 · Kansas · Minneapolis 2 · Montgomery 29 · Nashville · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 3 · Scranton 3 · Salt Lake City 1

THE TRAYLOR TY

TRAYLOR

Reduction Crushers

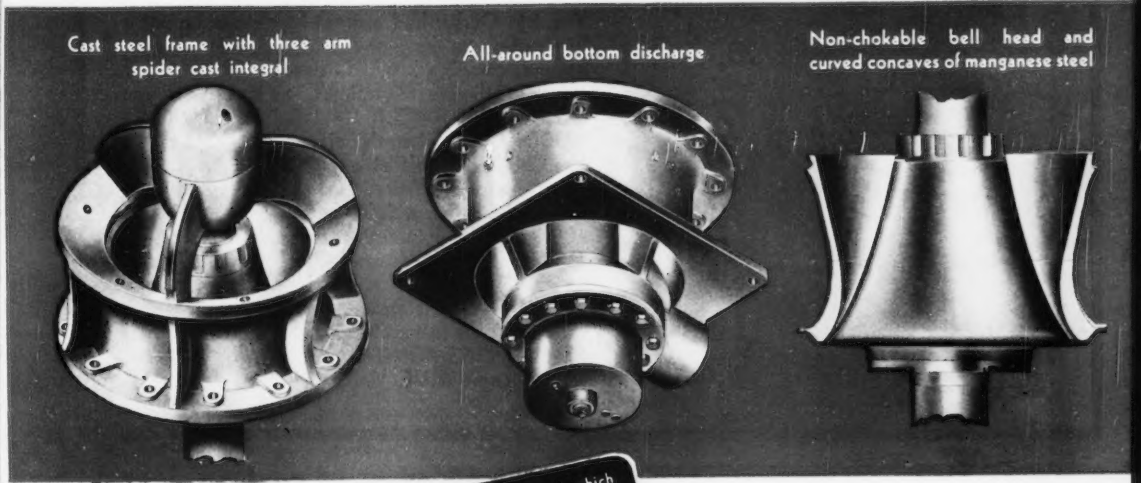
JAW CRUSHERS · GYRATORY CRUSHERS
FEEDERS · KILNS · COOLERS · DRYERS
GRINDING MILLS · CRUSHING ROLLS

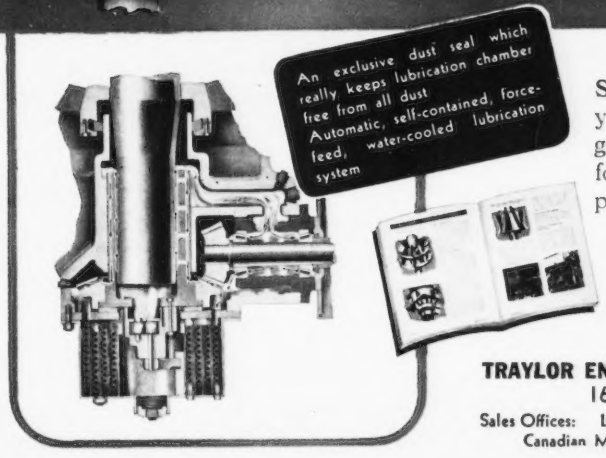
...a Secondary Crusher
OF PRIMARY IMPORTANCE

Proven by an Enviable Record of Profitable Operation

Working on all materials from hardest trap to limestone, the low maintenance and power costs of a Traylor TY in contrast to its great capacity of clean, cubical product means surer sales **with greater profit on every ton.**

Requiring little floor space and headroom, these crushers are offered in six sizes with feed openings from 3″ to 22″. Each size includes these heavy-duty features . . .


Cast steel frame with three arm spider cast integral
All-around bottom discharge
Non-chokable bell head and curved concaves of manganese steel


An exclusive dust seal which really keeps lubrication chamber free from all dust
Automatic, self-contained, force-feed, water-cooled lubrication system

Start your new plant or expand your old one with an eye to the biggest profits. Install a Traylor TY for all your secondary and light primary crushing.

Bulletin 5112 completely describes these outstanding crushers and shows many installations. Write for your copy today.

TRAYLOR ENGINEERING & MANUFACTURING CO.
164 Mill Street, Allentown, Pa.
Sales Offices: Los Angeles, Cal. Chicago, Ill. New York, N.Y.
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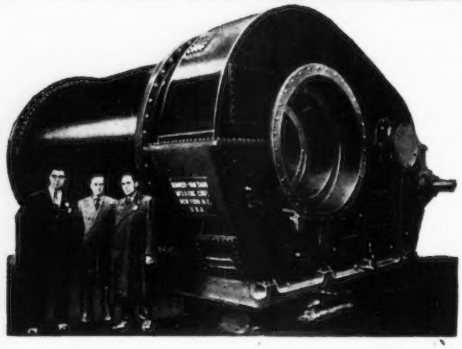
A "Traylor" Leads to Greater Profits

KVS GETS ADDED CRUSHING POWER

Mr. Corliss added a "pulley" to his engine to create added KINETIC ENERGY. We do the same in the "KVS" GEARLESS

Yes, Mr. Corliss had a great idea when he put a big pulley on his engine. The pulley whirled around, creating KINETIC energy. That added power to the steam engine. The same way, you get ADDED POWER IN A CRUSHER FOR NO ADDED COST when the big pulley in KVS Gearless Crushers whirls at a speed of 3,500 ft. per minute. What's more, the 8-ton pulley (as used in a KVS Crusher weighing 400,000 lbs.) whirls so easily it can be turned WITH TWO FINGERS! That's because there are NO power-eating noisy gears. If there were a bevel gear between the eccentric and the pulley, it would take six men with crowbars to turn it. In short, more CRUSHING for LESS POWER COST, is the big KVS idea — come TRUE.



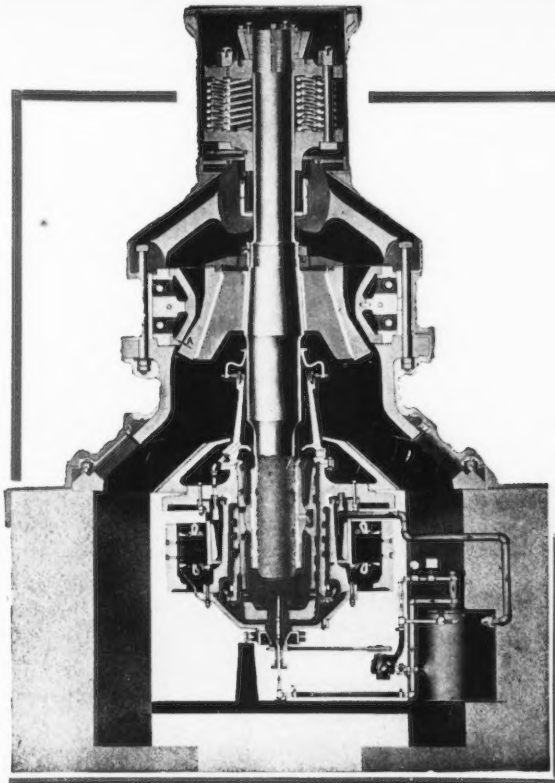
To get added grinding from less power, we carry "KVS" trunnions on OIL in our big TUBE and BALL MILLS

Think! "KVS" trunnions on large sized tube and ball mills are carried ON OIL. That means that the bearing never wears out, uses little power. All gears and bearings are AUTOMATICALLY SPRAYED with oil before the tube mill is started (Design patented). In 15 years no "KVS" gears or pinions have worn out on this type mill.

Also, the Kennedy INTEGRAL GEAR DRIVE enables motor to be DIRECT CONNECTED to driving shaft. Shaft is carried in roller bearings that CANNOT be misaligned or set wrong. This is a sure safeguard against wasted power.

NO WONDER USERS SAY—"KVS PRODUCTS ARE

WITHOUT ADDED COST—*this way*



Speaking of CRUSHING . . . .

LOCATION: NATIONALLY KNOWN MINING CO. NEW YORK STATE

CRUSHERS: FOUR NO. 37½ KENNEDY TYPE "S" ROLLER BEARING GYRATORY CRUSHERS

FEED OPENING: 6¼"; **DIAMETER OF HEAD:** 3 FEET

DISCHARGE SETTING: 7/32" CLOSED SIDE AT HEAD

CAPACITY EACH CRUSHER: 56 TONS PER HOUR

HORSEPOWER EACH CRUSHER: 48 HP.

CLOSED CIRCUIT OPERATION

GRADATION AS FOLLOWS:

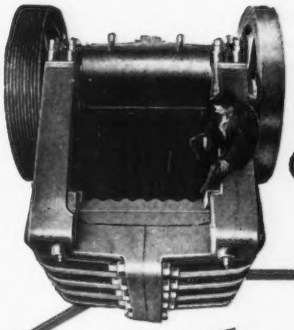
THE FIGURES!

99.8%	Minus	3	MESH
93.3	"	4	"
80.6	"	6	"
66.6	"	8	"
56.1	"	10	"
48.1	"	14	"
40.6	"	20	"

Can You Equal These Figures?

And to get BETTER crushing BOTH jaws share the load!

You get BETTER CRUSHING in the KVS Swing Jaw Crusher—because the angle of both swing jaw and stationary jaw is the same. Stationary jaw carries fully 50% of the load—result, you need LESS POWER to keep the swing jaw swinging and crushing. Another KVS idea . . . . the swing jaw is all one piece, except renewable crushing plate. Also swing and stationary jaws are interchangeable, both the same length, and reversible end-for-end giving two wears.

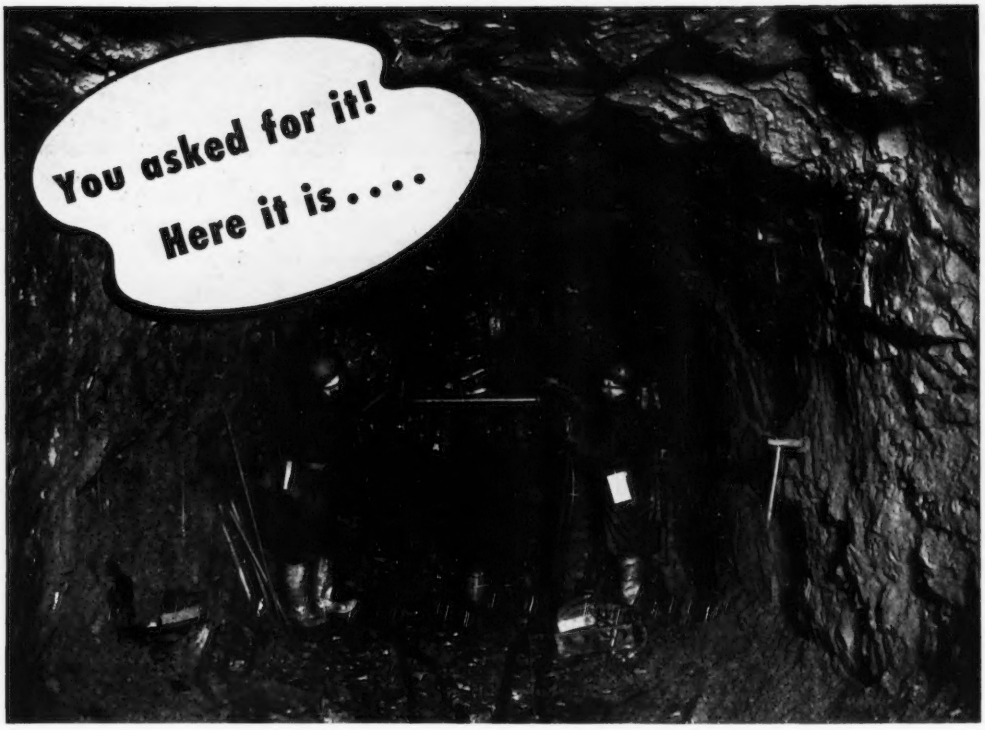


"KVS" SWING JAW

Kennedy-Van Saun
MANUFACTURING AND ENGINEERING CORPORATION
2 PARK AVE., NEW YORK 16, N. Y.
FACTORIES:
DANVILLE, PA., U.S.A.
CANADA, ENGLAND, FRANCE, AUSTRALIA

Write
For this "KVS" Bulletin. It gives complete technical data on "KVS" CRUSHERS—the facts you want before you invest good money.

THE PRODUCTS WITH THE TROUBLES LEFT OUT"



New *Homo-Flex* Heavy-Duty HOSE TEAM for WET DRILLING

Men who mine and quarry and excavate with wet drills have long demanded air and water hose that will withstand the scuffing and crushing of falling rock and rough working conditions. Manhattan engineers applied the Homo-Flex principle of hose construction to its hardest test . . and today you have your answer . . .

THE ROUGH, TOUGH TEAM OF *Condor* HOMO-FLEX HEAVY-DUTY AIR HOSE and HEAVY-DUTY WATER HOSE

Both of these rugged hose constructions feature extra thick cover protection that is literally "rubber armorplate". Every abusive blow rebounds from these new Homo-Flex constructions where lesser hose would be seriously gouged and injured.

Sharp bends over and around machines and rock are taken in stride by this tough team. Their sinewy hose walls stand up without kinking or collapsing. Thus, you can always be sure of a full feed of air and water to your wet drills.

Only Manhattan's exclusive principle of Homo-Flex construction makes possible this superior air and water hose team with their heavy-duty stamina to take this punishing service and still be flexible and easy to handle. In Homo-Flex, Manhattan engineers have developed a method of fusing tube, strength member and cover into one inseparable unit – for extra long life, extra margin of strength and safety, extra flexibility – extra value all around.

Don't overlook this opportunity to equip your wet drills with Condor Homo-Flex Heavy-Duty Air Hose and Heavy-Duty Water Hose–It's the team you asked for–developed specifically for your problems.

The Air Hose type with its oil-proof tube is also unmatched in performance in other heavy-duty mining, quarry, and construction operations.

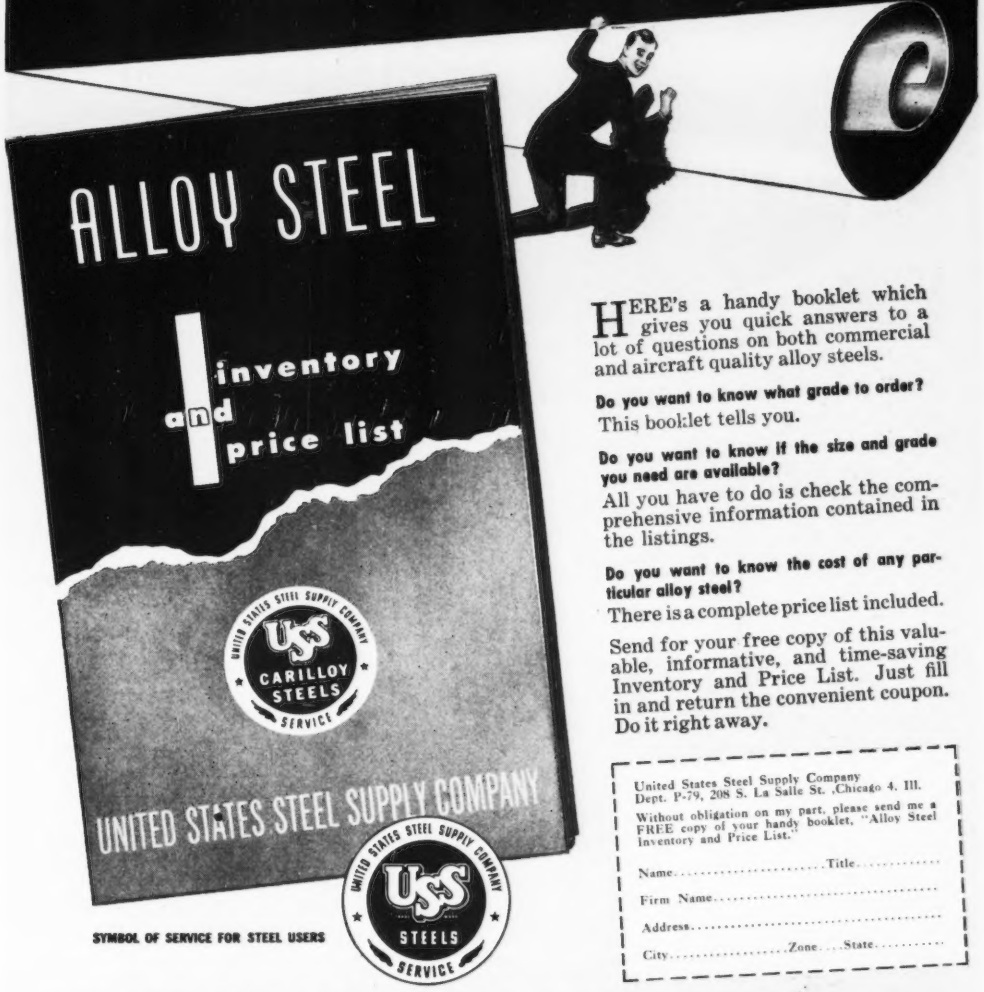
Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION – PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

If you use Alloy Steels, you'll need this *FREE BOOK!*



SYMBOL OF SERVICE FOR STEEL USERS

HERE's a handy booklet which gives you quick answers to a lot of questions on both commercial and aircraft quality alloy steels.

Do you want to know what grade to order?
This booklet tells you.

Do you want to know if the size and grade you need are available?
All you have to do is check the comprehensive information contained in the listings.

Do you want to know the cost of any particular alloy steel?
There is a complete price list included.

Send for your free copy of this valuable, informative, and time-saving Inventory and Price List. Just fill in and return the convenient coupon. Do it right away.

United States Steel Supply Company
Dept. P-79, 208 S. La Salle St. ,Chicago 4, Ill.

Without obligation on my part, please send me a FREE copy of your handy booklet, "Alloy Steel Inventory and Price List."

Name.....Title.....
Firm Name.....
Address.....
City.....Zone....State.....

UNITED STATES STEEL SUPPLY COMPANY

Warehouses: BALTIMORE · BOSTON · CHICAGO
CLEVELAND · LOS ANGELES · MILWAUKEE · MOLINE, ILL. · NEWARK · PITTSBURGH
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USS

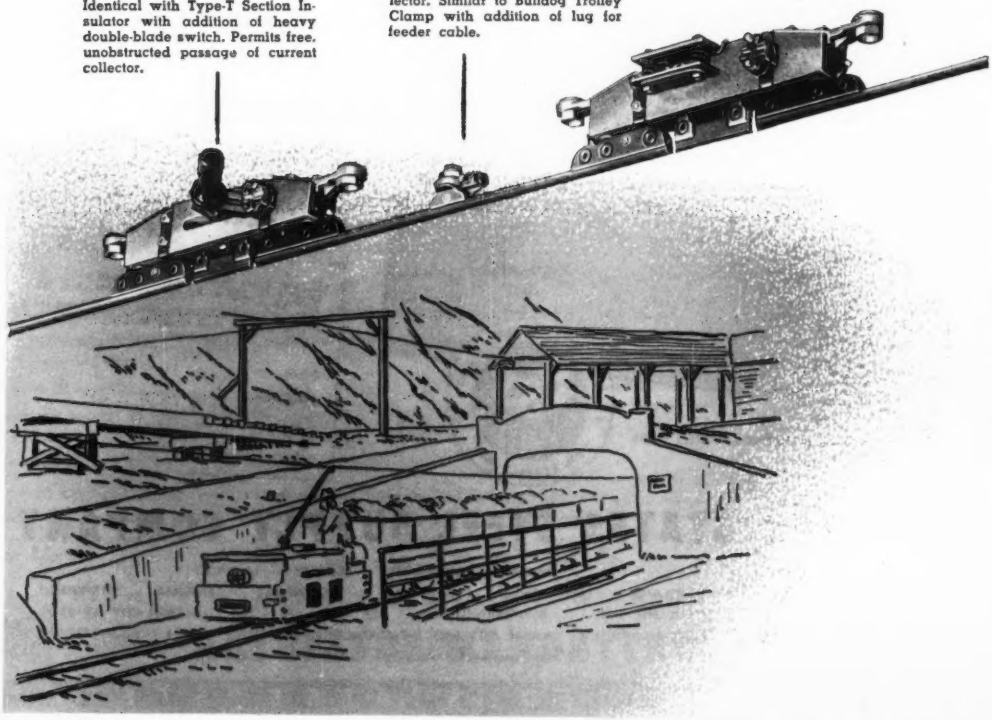
UNITED STATES STEEL

Now... for the first time... you can prevent ALL bumps in your Trolley Overhead System

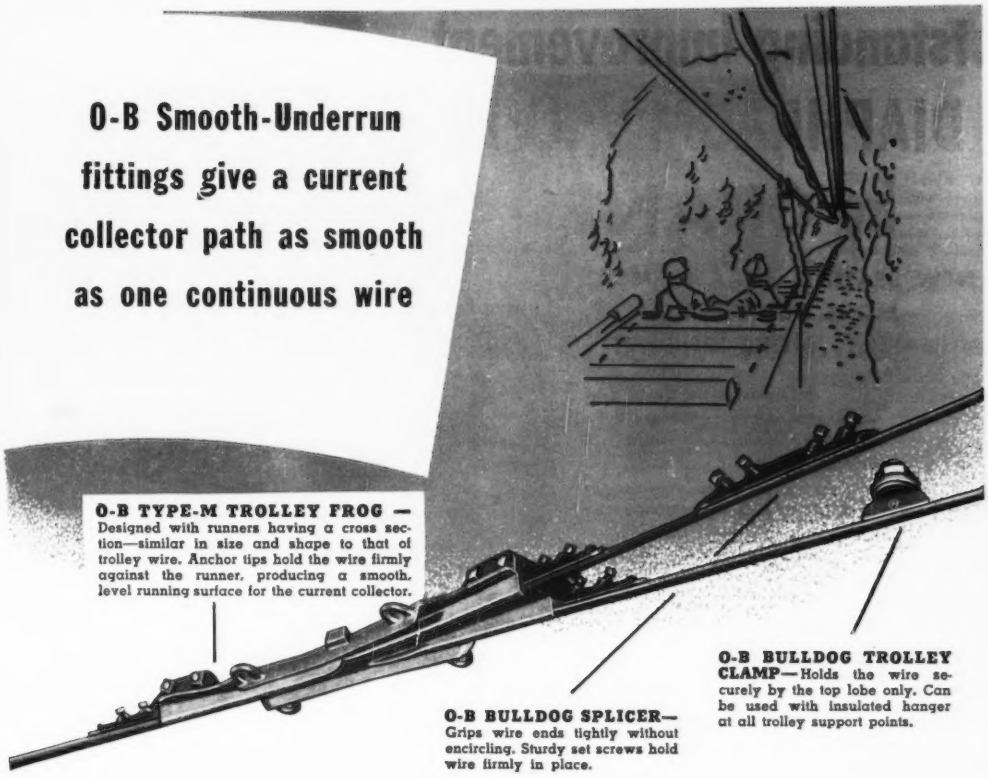
O-B TYPE-T SECTION INSULATOR SWITCH — Identical with Type-T Section Insulator with addition of heavy double-blade switch. Permits free, unobstructed passage of current collector.

O-B BULLDOG FEEDER CLAMP— Leaves bottom part of trolley wire as free, unobstructed running surface for current collector. Similar to Bulldog Trolley Clamp with addition of lug for feeder cable.

O-B TYPE-T SECTION INSULATOR — End runners grip wire by top lobe only. Center runner is adjustable to same underrun level as trolley wire.



O-B Smooth-Underrun fittings give a current collector path as smooth as one continuous wire



O-B TYPE-M TROLLEY FROG — Designed with runners having a cross section—similar in size and shape to that of trolley wire. Anchor tips hold the wire firmly against the runner, producing a smooth, level running surface for the current collector.

O-B BULLDOG SPLICER— Grips wire ends tightly without encircling. Sturdy set screws hold wire firmly in place.

O-B BULLDOG TROLLEY CLAMP— Holds the wire securely by the top lobe only. Can be used with insulated hanger at all trolley support points.

Have you ever wished you could install just one continuous piece of trolley wire in your mine? Bumps caused by wire encircling fittings in the overhead system are headaches to the haulage operator. They are a constant source of arcing and wire burning, lessening the life of both current collectors and trolley wire. Dewirements are more frequent.

While it is hardly possible to install wire in one continuous piece, you can obtain the same effect by building with fittings selected from O-B's complete line of Smooth-Underrun Materials. Instead of encircling the wire, O-B Fittings grip grooved, Figure 8 and No. 9 Section wire by the top lobe only, leaving the bottom part free and unobstructed. Your current collector is assured of a smooth, level transition from wire to frog or cross-over runner by means of separable anchor tips.

Because of these features, your locomotives can operate safely at higher speeds; wire wear will be lessened; fewer dewirements will occur. For your next trolley overhead system, insist on O-B Smooth-Underrun Fittings.

Ohio Brass

MANSFIELD, OHIO

CANADIAN OHIO BRASS CO., LTD.
NIAGARA FALLS, ONT.

3020-M

OHIO BRASS COMPANY, MANSFIELD, OHIO

I'd like some more information on O-B's Smooth-Underrun Fittings. Please send me Booklet 851-M.

Name _____

Title _____

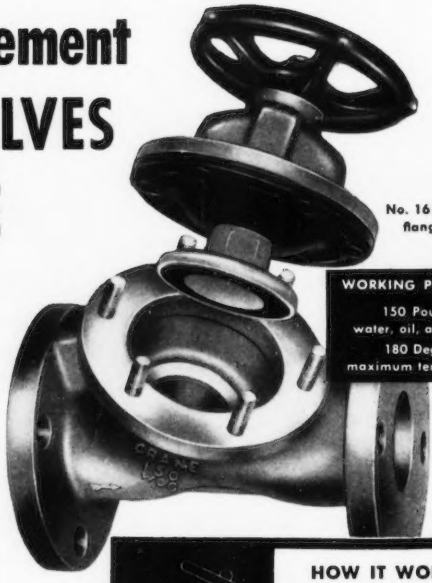
Company _____

Address _____

City _____ Zone ____ State _____

outstanding improvement in DIAPHRAGM VALVES by CRANE

NEW SEATING ARRANGEMENT MORE DURABLE... SAFER... MORE EFFICIENT



No. 1611, unlined, flanged ends.

WORKING PRESSURE:
150 Pounds
water, oil, air or gas
180 Deg. F.
maximum temperature

Now, after completing exhaustive tests, Crane presents this better diaphragm valve—better suited for more services under today's working conditions. Stemming from basic improvements, such as the radically new bonnet-sealing and valve-seating arrangement, this original Crane design introduces many outstanding service features like those shown here.

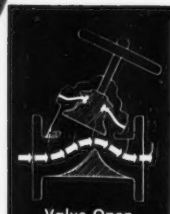
1. LONGER DIAPHRAGM LIFE, because diaphragm is used *only* to seal the bonnet—not for seating.

2. POSITIVE SHUT-OFF in case of diaphragm failure. This is an exclusive Crane safety feature.

3. ACCURATE SEATING—new flat face disc with durable, resilient seating surface assures tight closure on all fluids.

4. GREATER FLOW CAPACITY with reduced resistance and pressure drop, assured by Crane Y-pattern body design.

5. EASIER OPERATION—Crane separate disc and diaphragm construction takes less torque—fewer turns—to operate.



HOW IT WORKS

The Crane diaphragm serves one function only—sealing the bonnet. It is not subject to crushing and rapid wear. The seating member is a separate circular flat face disc, firmly attached to the stem and joined to the diaphragm with a special leakproof connection. This independent seating feature permits positive shut-off with no loss of fluid, even in case of diaphragm failure.

IDEAL FOR MINING SERVICES

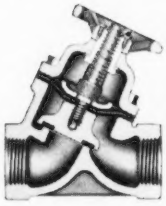
Stem cap for valves 2-in. and smaller.

Rugged and durable, these valves meet the need of mining operations, at the same time allowing maximum standardization and simplified maintenance. Unlined valves will handle all common services such as air and water. For corrosive and abrasive fluids, sandy waters, sludges, slurries, etc., Crane supplies these valves with tough neoprene lining. Valves exposed to rock slides or abrasive dust can be ordered with a cap to protect stem threads as shown here.

CATALOG FREE ON REQUEST

See the complete showing of new Crane diaphragm valves—unlined, with screwed ends, in sizes ½ to 2 in.; with flanged ends, ½ to 4 in. Neoprene-lined valves—flanged ends only—in sizes from ½ to 4 in. Ask your Crane Salesman—or write direct—for Catalog AD-1761.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Cross-section, No. 1610, unlined, screwed ends.

Cross-section No. 1615, neoprene-lined. 2½, 3 and 4-in. sizes.

EVERYTHING FROM . . .

VALVES
FITTINGS
PIPE

CRANE

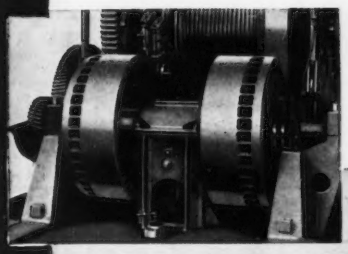
PLUMBING
AND
HEATING

FOR EVERY PIPING SYSTEM

look to P&H for added values

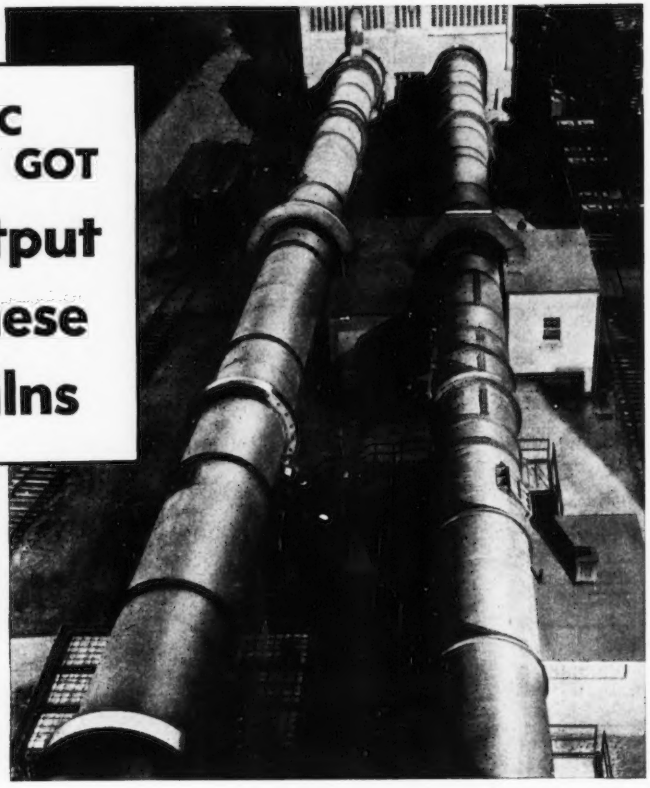
THE P&H MAGNETORQUE replaces the old frictions for swing and propel motions—transmits power electro-magnetically. It's smoother, more dependable, thoroughly proved.

*T.M. of Harnischfeger Corporation for electro-magnetic type clutch.



P&H

HOW BASIC REFRACTORIES GOT Bigger Output —With These *Longer* Kilns



MAGNEFER, used in open hearth, bessemer and electric furnaces as "shovel fill" refractory, is produced by Basic Refractories, Maple Grove, Ohio. Magnefer is made by dead-burning dolomite and iron ore flux to a temperature of approximately 3,000° F. in rotary kilns.

Like thousands of other companies, Basic Refractories was faced with the problem of stepping up production to meet a huge demand for their product.

A low-cost solution was found by making use of two existing short kilns at a great saving in first cost. These kilns were joined together and added-to (with a special section), making a 328 ft unit. The second kiln was then engineered and built by Allis-Chalmers to match the first.

Considerations of length, arrangement and the many other complex factors involved in a rotary kiln installation were worked out to obtain maximum economy as well as the desired capacity.

Result? Substantially increased production and a lower cost per ton than was possible with the shorter kilns.

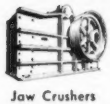
CHECK A-C EXPERIENCE, FACILITIES

Whatever your burning process, it will pay you to consult Allis-Chalmers.

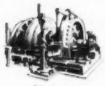
- A-C experience covers over 50 years of rotary kiln engineering.
- Hundreds of successful kilns installed.
- Allis-Chalmers shop and manufacturing facilities are unsurpassed.

The Allis-Chalmers representative in your area is as close as your phone. Call him today, or write for Rotary Kiln **Bulletin 07B6368.** Offices or distributors in principal cities in the U.S.A. and throughout the world.

Kilns, Coolers, Dryers



Jaw Crushers



Hoists

Mills

Gyratory Crushers

Vibrating Screens

AND OTHER EQUIPMENT FOR THE CRUSHING, CEMENT AND MINING INDUSTRIES

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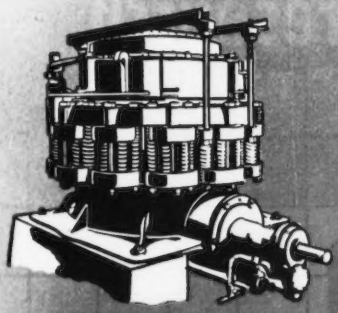
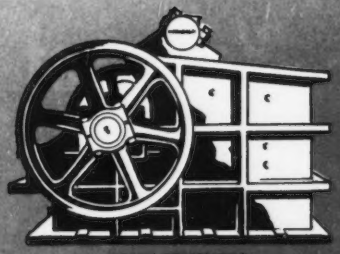
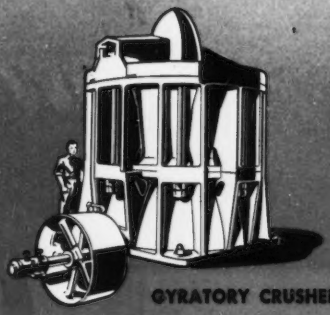


SECOND AND THIRD STAGE CRUSHERS



JAW CRUSHERS

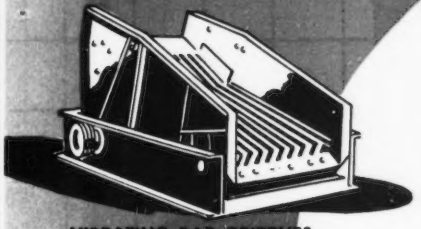


GYRATORY CRUSHERS

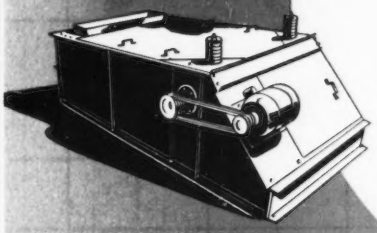
Mining turns to NORDBERG

INCREASING demands for all minerals require the development of new ore bodies and still further improvement of mining techniques and machinery. That is why so many of the world's outstanding mines are installing Nordberg equipment for processing ores and industrial minerals. Nordberg machinery for tomorrow's expansion programs and new deposit developments includes Gyratory and Jaw Crushers for primary crushing; Symons Cone Crushers, for second and third stage crushing; Vibrating Bar Grizzlies, Symons Rod Deck Screens and Horizontal Vibrating Screens for sizing, and a complete line of Ball, Tube, Rod and Compartment Grinding Mills. Nordberg Mine Hoists are built to meet every hoisting requirement. For dependable, low cost power, the complete line of Nordberg Diesels will provide the solution to your power problem.

Write for literature on the equipment you need.



VIBRATING BAR GRIZZLIES



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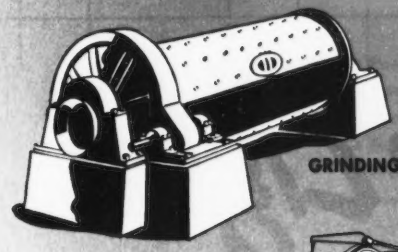
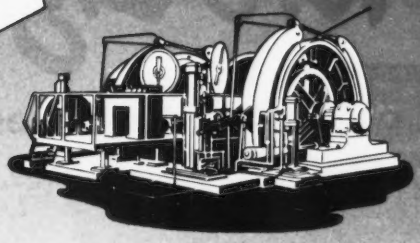
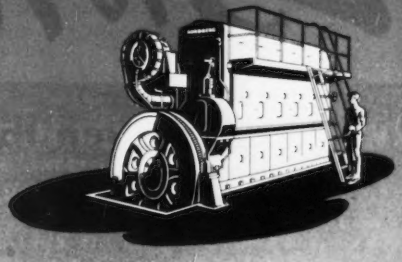


GRINDING MILLS



MINE HOISTS

DIESEL ENGINES



Now- Years of research

25% More Light

than even the previous Edison best!

bring the *newest and finest*

EDISON

MINER'S ELECTRIC CAP LAMP

MODEL *R-4*

Entirely new in its refinement of design, while retaining the unique EDISON nickel-iron-alkaline battery principle, the Edison Model R-4 Electric Cap Lamp presents today's maximum values in high performance, unfailing dependability, and years of useful life.

New research and new engineering of every detail, from headpiece to battery case, give the mining industry a cap lamp designed to serve men and management with higher standards of safety and efficiency than ever before available. *Demonstrations? Gladly, without obligation of any kind.*

- ***Positive "Spot"* Adjustment**
- ***Floodlight Beam* When Required**
- ***Comfortably Balanced* Headpiece**
- ***Four-Cell Edison* Nickel-Iron-Alkaline Battery**
- ***Welded Steel* Cell Containers**
- ***Tough Nylon Plastic* Outer Case**

MSA
SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES COMPANY
BRADDOCK, THOMAS AND MEADE STREETS . . . . . PITTSBURGH 8, PA.

At Your Service: 48 BRANCH OFFICES in the UNITED STATES

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Representatives in Principal Cities in Mexico, Central and South America CABLE ADDRESS, "MINSAF" PITTSBURGH

How BUCYRUS ERIE Blast Hole Drills Can Save You Money

On mine and quarry locations in many parts of the country they're talking about the rope-saving ways of Bucyrus-Erie blast hole drills. Economical through and through, these hard-driving rigs keep wire rope costs low, because they reduce rope wear. Here's how they do it:

1. Derrick-head shock absorber reduces rope strain, imparts extra resiliency, and absorbs peak shock loads.

2. Spudding beam and heel sheaves are rubber insulated. Live rubber rings between sheave and rim reduce the detrimental effect of shock and vibrations on wire rope.

3. Grooved drums mean even spooling . . . help prevent wire rope from twisting or kinking.

4. Sheaves over which wire rope travels are big. They present a large bend-radius, thus decrease line strain.

It will pay you to check these Bucyrus-Erie blast hole drills when you plan your new equipment purchases:

22-T	5⅝"	to	6⅝" holes
27-T	6 "	to	6⅝" holes
29-T	6 "	to	9 " holes
42-T	9 "	to	12 " holes

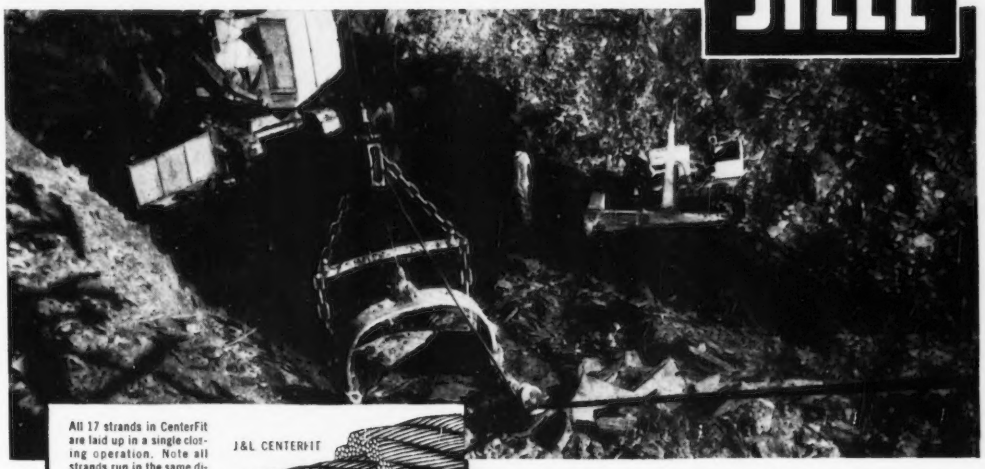
Gasoline or electric power is available for all machines . . . diesel for all except the 22-T.

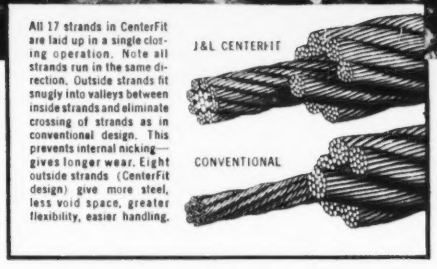
BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN

26848

GILLESPIE COAL COMPANY gets 30% Longer Service with J&L CenterFit Wire Rope

J&L STEEL




All 17 strands in CenterFit are laid up in a single closing operation. Note all strands run in the same direction. Outside strands fit snugly into valleys between inside strands and eliminate crossing of strands as in conventional design. This prevents internal nicking—gives longer wear. Eight outside strands (CenterFit design) give more steel, less void space, greater flexibility, easier handling.
J&L CENTERFIT
CONVENTIONAL

J&L CenterFit drag cable as seen from the fairlead sheave of a Marion 40-A dragline. The 3-yd. bucket is removing overburden from coal seam.

The "right wire rope for the job" pays off in longer service, reduced maintenance and greater profits.

A 30% average increase in service life! That's the performance record reported by Gillespie Coal Company when J&L CenterFit wire rope replaced a conventional dragline cable on a Marion 40-A dragline equipped with a 3-yd. bucket at its Lyons, Ind., open pit coal mine.

Average life of a conventional 6x19 dragline was 12 to 15 days; with CenterFit it was 17 to 22 days!

J&L CenterFit wire rope was selected for this application as a result of a careful analysis of operating conditions at the Lyons mine by Mr. L. S. Shaffer, J&L wire rope distributor in Brazil, Indiana. He knew the CenterFit design—exclusive with J&L—would provide the greater flexibility required for long service life on the small diameter sheaves and drums of this dragline. Actual performance records *proved* that CenterFit was *the right rope for this particular job.*

Perhaps you, too, can use J&L CenterFit wire rope to advantage. In many places it gives improved performance and longer service.

We have just issued a new handbook, "*Wire Rope Is a Machine.*" This 96-page illustrated, pocket-size book is written *for the man on the job.* Tells how to select the correct wire rope . . . How to install, operate and maintain wire rope for maximum service. If you use wire rope, we'll gladly send you a copy. The coupon is for your convenience.

Jones & Laughlin Steel Corporation
412 Jones & Laughlin Building
Pittsburgh 19, Pa.

Please send me a free copy of your new handbook, "Wire Rope Is a Machine."

Name_____

Title_____

Company_____

Address_____

JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L *manufactures a full line of carbon steel products, as well as certain products in* OTISCOLOY *and* JALLOY *(hi-tensile steels).*

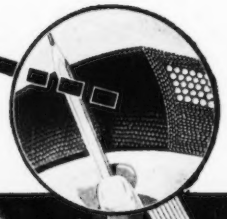
PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES • STRUCTURAL SHAPES • HOT AND COLD ROLLED STRIP AND SHEETS • TUBULAR, WIRE AND TIN MILL PRODUCTS • "PRECISIONBILT" WIRE ROPE • COAL CHEMICALS

This Simple Test
Shows Exactly How

The CONCAVE SIDE...

(U.S. Patent No. 1813698)

Saves You Money!



The Mark of SPECIALIZED Research

Pick up *any* V-belt having the ordinary straight sides and *bend* the belt. Three things will happen, right before your eyes.

(1) The top of the belt is under tension and grows *narrower.* (2) The body, under compression, becomes wider. (3) The sides of the belt *bulge out.* (Figures 1 and 1-A, below.)

Straight-Sided V-Belt

How Straight-Sided V-Belt Bulges in Sheave-Groove

This bulging of the straight-sided V-belt in its sheave-groove costs you money in *two* ways—(1) The bulge causes uneven sidewall wear—*shorter life!* (2) The bulging side cannot evenly grip the wall of the sheave groove—a loss in *transmission efficiency!*

In figures 2 and 2-A, you see how the precisely engineered *concave* side of the Gates Vulco Rope exactly corrects this bulging.

Gates Vulco Rope with Concave Side.

No Side Bulge. Precise Fit in Sheave-Groove.

Two distinct *savings* result. (1) The Gates Vulco Rope wears evenly—*longer life!* (2) The entire side-wall grips the pulley—carries heavier loads and *sudden load increases* without slippage:—saves *belts* and also *saves power!*

The Concave Side is *MORE IMPORTANT NOW* Than Ever Before

Because the sides of a V-Belt are what actually drive the pulley, it is clear that any increased load on the belt means a heavier load that must be transmitted to the pulley directly through the belt's sidewalls.

Now that Gates *SPECIALIZED* Research has made available to you SUPER Vulco Ropes—carrying fully 40% higher horsepower ratings—the life-prolonging Concave Side is naturally more important in conserving belt life today than ever before.

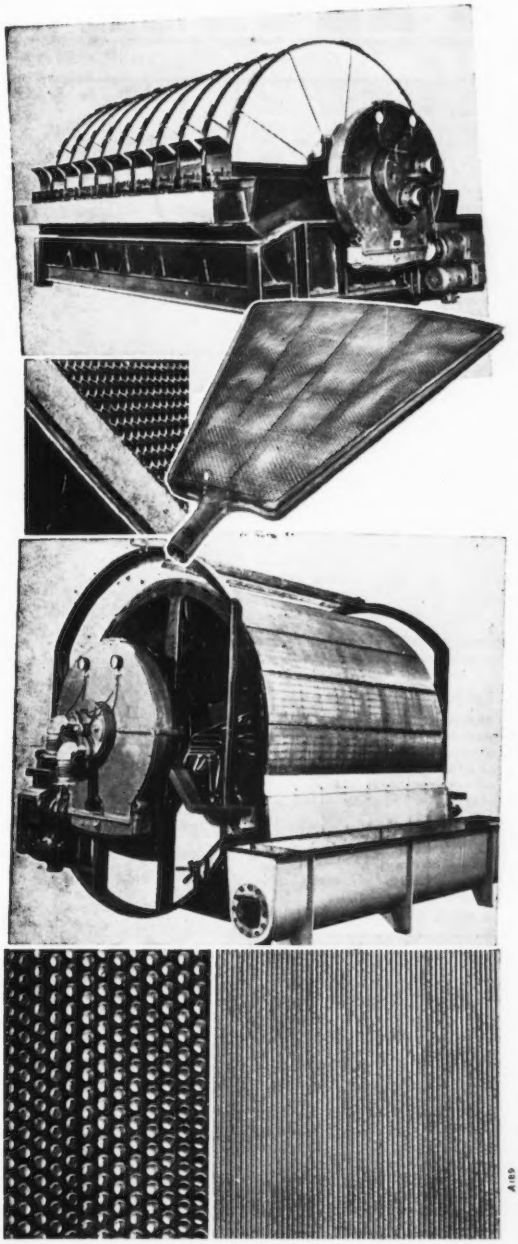
496

GATES VULCO ROPE DRIVES

Engineering Offices and Jobber Stocks IN ALL INDUSTRIAL CENTERS of the U. S. and 71 Foreign Countries

THE GATES RUBBER COMPANY
DENVER, U.S.A.
The World's Largest Makers of V-Belts

Greater tonnage — lower moisture with Eimco Continuous Vacuum Filters



Eimco filters are designed individually, to serve each industry in each field. They're built of the best materials available by skilled craftsmen, using the most modern equipment in modern plants.

Each Eimco filter whether it is of wood, stainless steel, Monel, everdur or some combination of wood or metal, whether it's a drum or disc type, has definite superior characteristics, which make the Eimco filter, in any industry, dewater more cake per square foot or filter area, bring the cake off the drum or disc with a lower moisture content and have a lower maintenance cost per ton of cake delivered. This is the vital requirement of every successful filter installation.

The research facilities of our complete test laboratories with full pilot plant facilities are available to assist you. Write for information on this service.

Eimco Continuous Vacuum Filters are giving superior performance in every processing field: food, chemical, metallurgical, sewage and many others.

Top to bottom:— Eimco Disc type continuous vacuum filter size 10'6"x10 discs. All metal disc construction gives better drainage and long life where corrosive conditions demand. Note caulking groove (inset) for cloth covering. Eimco 8'x8' stainless-steel drum-type filter with repulper. Many types of drum covering are used including perforated metal sheet and wire cloth.

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 8, UTAH, U. S. A.

BRANCHES: NEW YORK, CHICAGO, BIRMINGHAM, EL PASO, SACRAMENTO, MANILA

AFFILIATED COMPANIES: SOCIETE EIMCO, PARIS, FRANCE

EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND

AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

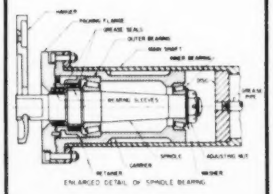
A169

Heres why an AKINS

Lower costs depend upon production volume; the key to production volume is mechanization, and the key to mechanization is standardization. That's the reason the spirals of AKINS Classifiers have been standardized at a pitch of half the diameter. By using the design that independent tests and our own laboratory experiments prove is best, it is possible to give you a stronger, more economical classifier for your money.

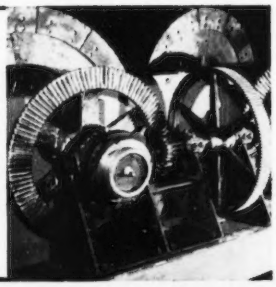
Compare these construction details with any other machine on the market:

BEARINGS **Standard** Timken tapered roller bearings support the main shaft at the lower end. The submerged bearing is of patented design, together with the centralized method of lubrication, and provides a water- and grease-tight bearing chamber. Grease seals are easily inspected and renewed without exposing the bearing parts to grit and dirt. Both the upper and lower shaft bearings are lubricated from the same spot, and will provide long, trouble-free life.

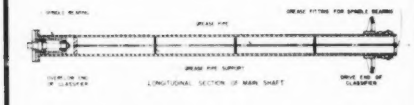


ENLARGED DETAIL OF SPINDLE BEARING

DRIVE GEARS **Standard** pitch gears are used to match any standard drive mechanism. The recommended AKINS drive is an extra strength bevel gear and pinion back-geared through cut-tooth spur gears to provide sufficient gear ratio for use of standard electric motors with V-belt drives. Other available drives include variable speed drives, where necessary.

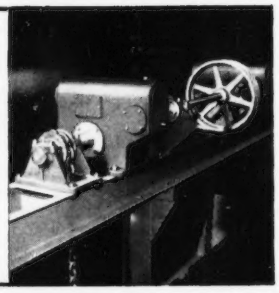


MAIN SHAFT **Standard** seamless steel tubing of proper wall thickness-for-diameter; thoroughly tested for overload stresses to eliminate shaft failures.

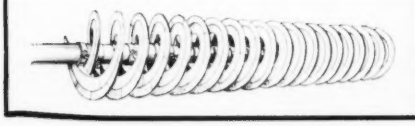


LONGITUDINAL SECTION OF MAIN SHAFT

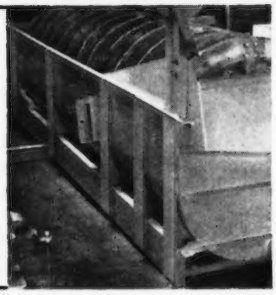
LIFT MECHANISMS **Standard** motor driven or hand-operated lifting mechanisms are always recommended, although special designs are provided where required. All feature standard alloy constant-pitch lifting chains and chain pocket sheaves of exclusive AKINS design. There is no possibility of slippage, and sand or slime on the chain cannot affect the operation of the mechanism.



SPIRAL FLIGHTS **Standard** 12° pitch angle flights are formed of heavy steel plate to withstand extreme abrasive action. Points of greatest wear are protected with hard iron wearing shoes which are easy and inexpensive to replace. Flight arms are of cast steel clamped securely about the shaft and give full support and protection against overload to both shaft and flights.



TANK CONSTRUCTION **Standard** steel plate is used in the manufacture of all AKINS tanks. All seams and joints are welded, and heavy frame channels and side members are welded to the tank. The entire assembly utilized the tank plate as the web in a large beam—so strong that the entire machine may be mounted on simple piers or on structural members of a steel building without extra substructures.



is a better buy for your Classifier Dollar...

HERE'S WHERE CLASSIFIERS GO

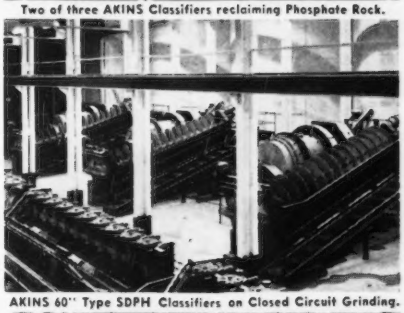
AKINS dominate with 316 Spiral Classifiers in 6 fields

Spiral classification has become standard practice in six major fields, and in every one AKINS machines are considered standard for plant installations. The plants listed below are world famous, many are at the half-century mark. They all have another thing in common: every one is using AKINS Classifiers—316 machines in these six fields.

CLOSED CIRCUIT ALL GRAVITY GRINDING 200 MACHINES	Phelps Dodge Corp. Cananea Consolidated Copper Co. Anaconda Copper Mining Co. Climax Molybdenum Co. Golden Cycle Corp. Granby Consolidated Mining, Smelting & Power Co., Ltd. U. S. Vanadium Corp. U. S. Smelting, Refining & Mining Co. New Jersey Zinc Co.
IRON ORE CONCENTRATION 50 MACHINES	Butler Bros. Cleveland-Cliffs Iron Co. Pickands, Mather & Co. Hanna Ore Co. Sheffield Steel Co. Alan Wood Steel Co. Oliver Iron Mining Co.
PHOSPHATE ROCK RECOVERY 16 MACHINES	Swift & Company International Minerals & Chemical Corp. Davison Chemical Corp.
GLASS SAND WASHING 15 MACHINES	Pittsburgh Silica Sand Co. Sun Sand Co. Au Buchon Silica Sand Co. United Clay Mines Corp. Cumberland Cement & Supply Co. Deckers Creek Sand Co.
INDUSTRIAL & COMMERCIAL SAND PREPARATION 10 MACHINES	Industrial Silica Corp. L. G. Everist & Co. New Jersey Pulverizing Co. Reitz & Crites Sand Co.
HEAVY MEDIA CONCENTRATION 25 MACHINES	Butler Bros. Cleveland Cliffs Iron Co. Hanna Ore Co. Barton Mines Corp. H. C. Frick Coke Co. U. S. Coal & Coke Co. American Zinc Co. Stanley Mining Co.

This is only a partial list of important users of AKINS machines. The first AKINS installation was made in the Cripple Creek area of Colorado in 1909. Since then no important installation of AKINS Classifiers has ever been replaced with machines of any other make!

Two of three AKINS Classifiers reclaiming Phosphate Rock.



AKINS 60" Type SDPH Classifiers on Closed Circuit Grinding.

More AKINS Simplex Classifiers used in Closed Circuit.

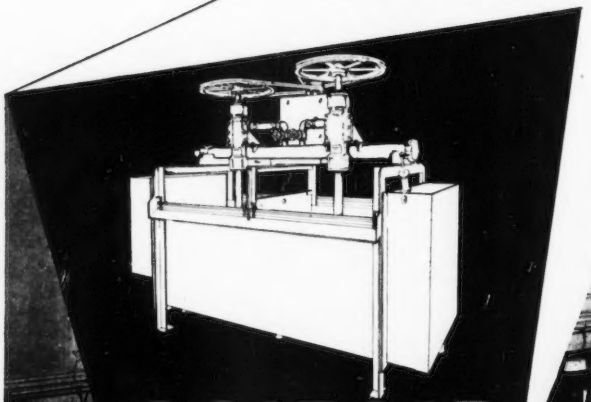
For details and free engineering service on your application write

COLORADO IRON WORKS CO., DENVER 2, COLO.

MAIN OFFICE AND WORKS, Denver 2, Colorado, U. S. A., Canadian Locomotive Co., Ltd., Kingston, Ont., Can.; Wright Bros., Credit Foncier Bldg., Vancouver, British Columbia Sales Agents; Head, Wrighton & Co., Ltd., Stockton on Tees, Engl.; John Carruthers & Co., (Pty.) Ltd., Sydney, Aus.; Head, Wrightson & Co., S. A., (Pty.) Ltd., Johannesburg; Edw. J. Nell Co., Manila, P. I.

COLORADO IRON WORKS COMPANY

the FUTURE looks to GALIGHER ENGINEERING



AGITAIR
FLOTATION MACHINE

For full details on this comprehensive service, consult our engineers or explain your requirements in written communication.

FROM ORE TESTING TO ORE RECOVERY

Before mill design or construction can be intelligently planned, ore testing is essential to determine optimum flowsheet for the treatment of the ore in question. Galigher service is keyed to this basic requirement of sound operation . . . well equipped with testing plant, laboratory equipment and technical skill — not to mention the many years of pioneering experience that has kept the name Galigher in the forefront of metallurgical operations throughout the world.

THE GALIGHER COMPANY

METALLURGICAL DIVISION

CONSULTATION • ORE TESTING • PLANT DESIGN • CONSTRUCTION

AGENTS IN ALL PRINCIPAL FOREIGN MINING DISTRICTS

HOME OFFICE
565 WEST 9th SOUTH
SALT LAKE CITY, UTAH
P.O. BOX 209

EASTERN OFFICE
921 BERGEN AVENUE
JERSEY CITY
NEW JERSEY

Ingersoll-Rand Paving Breakers have Everything

Everything the Owner Wants...

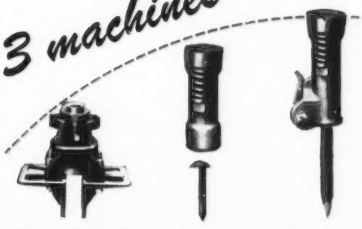
- Plenty of power
- Low air consumption
- Low upkeep costs
- Sound design
- Dependability
- Interchangeable frontheads (Breaking, pile driving, spike driving)
- Operator appeal

Everything the Operator Wants...

- Easy holding
- A big sturdy handle
- A long smooth surface for the knee in prying
- Distributed weight and correct length
- Gradual throttle release with automatic cut off
- Out of the way air connection
- Easily opened and closed latch bolt

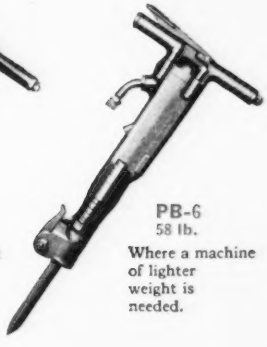
Ingersoll-Rand PB-6 and PB-8 Paving Breakers meet **all** of these requirements. What's more, they have these **extra** features: A double-kicker port valve . . block-type piston . . full air cushioning . . four-bolt handle construction . . oil reservoir, long anvil-block bearing . . extra strong fronthead bolts and springs. Because PB-6 and PB-8 Paving Breakers have everything you want, you can buy them with complete confidence. They are giving stellar performance the world over.

3 machines in One



Three interchangeable frontheads enable the powerful PB-8 Paving Breaker to be quickly converted from a paving breaker into a pile driver or a spike driver.

PB-8
82 lb.
For the heaviest duty service.



PB-6
58 lb.
Where a machine of lighter weight is needed.

Ingersoll-Rand
11 Broadway, New York 4, N. Y. 426-S

ROCK DRILLS • COMPRESSORS • AIR TOOLS • DIESEL AND GAS ENGINES • CENTRIFUGAL PUMPS • VACUUM EQUIPMENT

IMPORTANT JOB FOR

In 1929—the first 42-ounce duck conveyor belt ever developed was introduced by United States Rubber Company.

In 1938—"U. S." introduced the first 48-ounce duck conveyor belt—a new and revolutionary engineering achievement.

And now—"U. S." engineers have perfected an amazing new belt embodying a duck in which two great textiles are combined—Ustex* for strength, Nylon for flexibility. This new belt is capable of handling heavier loads, longer centers and higher lifts than any belt ever developed.

A GREAT NEW BELT !

Ore mine extends operations with belt conveyor equipped with super-strong USTEX-NYLON

The grade from pit level to ground level was 3% by rail. Installation of the new belt permitted a 25% grade. *Total vertical lift*—255 feet. *Speed*—550 feet per minute. *Delivers* 700 tons per hour.

When this mine reached a point where steam rail haulage became impractical, the mine officials found the answer in the belt conveyor . . . replaced 2½ miles of track with 2,200 feet of Ustex-Nylon Belting.

Moreover, the use of belting now permits the recovery of benches and a sizeable volume of ore that otherwise could not be handled.

Ustex-Nylon Belting is 2½ to 4 times stronger than the strongest duck-and-rubber conveyor belt ever produced. It is made by combining nylon with Ustex*, the world's strongest cotton yarn—developed by United States Rubber Company. The flexible nylon provides proper troughability.

Ustex-Nylon is the best for extra-big conveyor jobs. It permits higher tensions, longer hauls, higher lifts and greater tonnages. This belt is less than half the weight of a conventional duck-and-rubber belt of equivalent strength. It can be repaired quickly in case of accident, using same methods known to maintenance men.

Many materials-handling problems once considered impractical with belt conveyors can now be solved by using Ustex-Nylon Belting. We will gladly talk over your own particular questions with you.

Write Mechanical Goods Division, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

*Reg. U. S. Pat. Off.

FOR SUPER-TENSION CONVEYING JOBS

ORE • COAL • ROCK • GRAVEL

PRODUCT OF

U.S.RUBBER

SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

It certainly takes POWER to Grind Ore and it's best done in a MARCY Mill

It takes a certain amount of power to grind a ton of a certain ore to a certain size, regardless of mill design. The more power utilized by a mill, the greater the capacity or the finer the grinding. Size for size, MARCY Mills will grind more ore than other types because they utilize the maximum of power and utilize it efficiently. Their low pulp line permits greater impact of the grinding media, quicker removal of finished material with a minimum of overgrinding, and a higher pulp density for better contact between grinding media and ore. This means less floor space, power, and operating labor for a plant equipped with MARCY Mills. That is why MARCY Mills are found in so many grinding plants throughout the world, particularly in large installations.

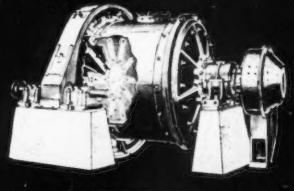
MARCY Open-End Rod Mills, pioneers in fine crushing or coarse grinding—Application of MARCY Open-End Rod Mills to take a coarse feed and, in one pass through the mill, prepare a fine product for the regrind mills is not new. They were doing this in 1919. To the right are a few of the early installations on this work.

As time went on, selective flotation replaced gravity concentration and changed flowsheets for the time being, but MARCY Open-End Rod Mills pioneered in single pass grinding, just as MARCY Ball Mills pioneered in major grinding developments since 1914.

A Few Early Installations	Date
3 Phelps Dodge plants	1919-1920
Cia. Minera Beneficiadora de Inde	1921
The Fresnillo Company	1920
Southwestern Graphite Company	1923
Cerro de Pasco	1925
Hollinger Cons. Gold Mines	1923
Neg. Minera de La Mazata	1923
S. F. Mines of Mexico, Ltd.	1925
Bertha Mineral Company	1926
Cia. Minera de Penoles	1926

MARCY BALL MILLS Since 1914 have been world-wide choice for many plants. One of the companies listed (right) recently placed with us the largest single order for grinding equipment ever bought for any plant from any manufacturer! Repeat orders tell the worth of equipment, and many of the companies listed to the right, as well as others not shown, have placed successive orders for MARCY Ball Mills.

- Phelps Dodge Corporation
- Chile Exploration Co.
- American Smelting & Refining Co.
- U. S. Smelting, Refining & Mining Co.
- Kennecott Copper Corporation
- Climax Molybdenum Co.
- American Metals Co.
- Newmont Mining Co.



OTHER PRODUCTS

Massco Fahrenwald Flotation Machines; Genuine Wilfley Tables; Massco-McCarthy Hot Millers; Rock Bit Grinders; Density Controllers; Belt Feeders; Rubber Pinch Valves; Assay and Laboratory Supplies and Equipment; Complete Milling Plants.

CONTACT YOUR NEAREST MASSCO OFFICE

Main Office: DENVER, COLO., U.S.A.; El Paso; Salt Lake City; 1775 Broadway, New York, N. Y. Representatives: Canadian Vickers, Ltd., Montreal; W. R. Judson, Santiago and Lima; The Edward J. Nell Co., Manila, P. I.; The Ore & Chemical Corp., 80 Broad St., New York 4, N. Y., for Continental Europe.

For over a third of a century, MARCY Mills have been designed and built from experience and specialization in grinding. Qualified, experienced engineers and extensive field and test data assist in the selection of the proper size and type MARCY Mill for your grinding requirements. MARCY Mills assure you of appreciable savings due to . . .

These Features	with	These Results
Low Pulp Line		Increased Tonnage, Lower Per-Ton Costs
Larger Discharge Opening		Quicker Removal of Finished Product
Rapid Circulation of Mill Contents		Minimum of Overgrinding
Minimum Cushioning of Grinding Medium		Higher Pulp Density, Greater Efficiency
Greater Impact Drop		Improved Metallurgy in Many Flowsheets

Our world-wide metallurgical experience is at your service without cost or obligation. Ask for complete information.

The Mine & Smelter SUPPLY COMPANY

Two Blowers . . . One Purpose:
30 to 100% More Air

Why two totally different blower types? Because the requirements of mine ventilation fall into two entirely different categories.

For high pressures, long pipe lines, use the Coppus VENTAIR (centrifugal type). For medium pressures, shorter pipe lines, the Coppus VANO (propeller type) is best. One or the other will give you more air per given power consumption than other blowers — from 30% to 100% more. Can be used as blowers or exhausters, capacities up to 90,000 CFM, with compressed air or electric motor drive.

Only Coppus makes both types. And, for quick recognition, each wears the famous "Blue Ribbon," distinguishing mark of top-quality engineering, materials and performance. This blue band is your guarantee of better mine ventilation . . . Look for it.

Representatives listed in MINING CATALOGS. Other Coppus "Blue Ribbon" products: steam turbines, gas burners, heat katers, air filters, blowers and exhausters for special purposes. ***See also THOMAS' REGISTER . . . Coppus Engineering Corporation, 282 Park Ave., Worcester 2, Mass.***

COPPUS ENGINEERING CORPORATION
287 Park Avenue, Worcester 2, Mass.

Please send: Bulletin 130.

Name.....

Company.....

Address.....

Not just a loader— a RockerShovel!

The Eimco RockerShovel has many features that distinguish it from common ordinary loaders.

It has the background of being the original overhead loader with all the experience gained through development which influences its present design.

The RockerShovel is constructed to be most practical underground—all alloy STEEL castings, simple in design, fast in operation.

Records of mining companies prove that it stays underground longer (continuous shift operation) and costs less to operate both in air consumption and maintenance on a per ton loaded basis.

These features, along with the fact that it is the only mechanical loader that is tailor-made to fit your mining conditions, are some of the reasons why we call it the RockerShovel.

The RockerShovel is the best in mechanical loading. You can't beat a RockerShovel.

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 8, UTAH, U. S. A.

BRANCHES: NEW YORK, CHICAGO, BIRMINGHAM, EL PASO, SACRAMENTO, MANILA

AFFILIATED COMPANIES: SOCIETE EIMCO, PARIS, FRANCE
EIMCO (GREAT BRITAIN) LTD., LEEDS 11, ENGLAND

AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

8205

Memo from our
RAW MATERIALS DEPT.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION
OFFICE MEMORANDUM

DATE 8/11/48

TO Metallurgical Dep't.

SUBJECT: Performance of Heat Treated JALLOY Steel at Benson Mines, Star Lake, N. Y.

1" x 6" heat-treated JALLOY #3 flats to reinforce truck-body bottoms and doors. Service--severe impact loading of hard rock magnetite ore from 5-yd. shovel. Year round operations in temperatures to minus 47°F. Severe abrasion in unloading. Installations have been in service 13 months --305,000 tons handled per truck. Units equipped with these flats maintain bottom flatness and clean readily. Insignificant wear at this date indicates at least 2 years life before replacement is necessary.

WHAT better "laboratory" could we find to prove the qualities of J&L Steel than in the equipment required in our own operations?

The handling and moving of heavy, abrasive ore-bearing rock, at our Benson Mines, is a rugged test for any equipment. Yet our stone trucks equipped with heat-treated J&L JALLOY Steel reinforcing strips have run *more than a year* without bottom replacements. *And recent reports indicate at least two years life!*

These JALLOY strips receive the full impact of huge rocks *dropped* into the truck bodies, and withstand the abrasion caused by dumping load after load. This continuous resistance to shock is particularly noteworthy because of the embrittling effect of the sub-zero temperatures encountered during winter months.

J&L JALLOY is a fine-grain, heat-treated steel made in a wide range of physical properties with tensile strengths of 155,000 to 180,000 lbs. per sq. inch. Its inherent ability to withstand shock and abrasion adds life to equipment that must be tough and strong—such as: Rock crushers, Scrapers, Bulldozers, Dump cars, Power-shovel buckets, Truck bodies, Sandblasting equipment—or wherever abrasion and impact are limiting factors.

Manufacturers of trucks and trailers designed for heavy service will find JALLOY an excellent material for body bottoms, reinforcing strips exposed to severe abrasion, tail gates and many other applications. You'll find that JALLOY is a steel that stands up when the going gets tough. For more complete information, let us send you the booklet: "*Jalloy*—J&L *Alloy Steel*." It includes data on properties, heat treatments and workability. The coupon at the right is for your convenience.

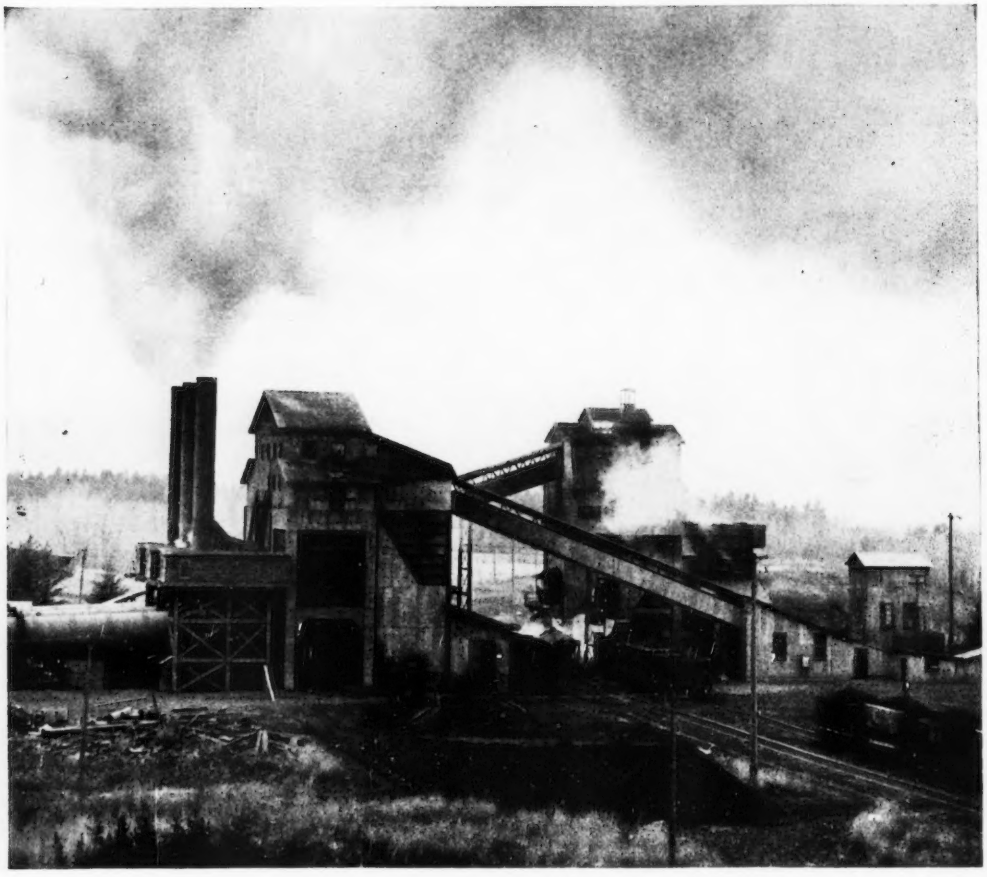
Jones & Laughlin Steel Corporation
412 Jones & Laughlin Building
Pittsburgh 19, Pennsylvania

Please send me your booklet: "Jalloy—J&L Alloy Steel."

Name _____ Title _____

Address _____

JONES & LAUGHLIN STEEL CORPORATION



8 Million Tons in 28 Years...

Proves Sound Design of Handling Equipment

Built 28 years ago, the S-A conveyor system in this plant has proved its sound design by handling 8 million tons of wet iron ore through separation, crushing, drying, screening and storage . . . and it is still going strong!

Designing conveying systems to handle bulk materials in large volume at lowest cost per ton has been the work of S-A engineers for almost 50 years. Their "grass-roots" knowledge of the sound design and engineering of bulk materials handling systems is yours for the asking.

S-A engineers will be glad to give you their recommendations for a new conveyor unit or an entirely new handling system. Write us today.

Principal S-A equipment in this plant consists of a traveling chain grizzly, a 110-foot long pan conveyor, three pan feeders and five belt conveyors. Chain grizzly receives wet ore from pit and passes fines to belt conveyor below. Lumps are routed to crusher via pan conveyor and crushed ore rejoins fines on belt conveyor to storage bins. S-A pan feeders withdraw wet ore from bins and feed to rotary dryers. Other belt conveyors move dry ore to storage.

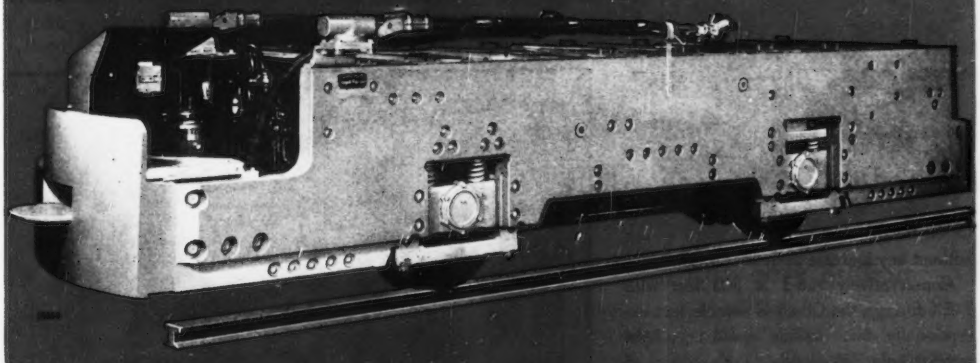
STEPHEN S-A DAMSON MFG. CO.

4 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

A GOODMAN HEAVY HAULAGE LOCOMOTIVE

For Metal Mine Service



Weight . . . . . 20 tons	Deck height . . . . 44½ inches
Motors . . . . . 2, each 120 hp	Width . . . . . 63 inches
Gauge . . . . . 36 inches	Length . . . . . 20 feet, 4 inches
Capacity . . . . . 50-ton train at 8 mph on level track	Wheel base . . . . 100 inches

Other features: roller bearing journals, semi-magnetic contactor control, straight air brakes, air sanders, automatic transfer switch for trolley poles, bumper plate for protection of motorman.

Goodman builds a complete line of trolley, storage battery, and combination type locomotives for coal and metal mines.

HALSTED ST. AT 48TH GOODMAN MANUFACTURING COMPANY CHICAGO 9, ILLINOIS

In Great Britain: The Distington Engineering Co., Ltd.

Modern Tools for

The CP line of Rock Drills is complete . . . Sinkers for the lightest to the heaviest jobs . . . ROTORdrifters with 3″ and 3½″ cylinder bore . . . Stopers for light and heavy duty . . . Air-powered and gasoline-driven Diamond Drills . . . Demolition Tools from the 25-pound to the 90-pound class. Whatever the job, you will find a CP drill expressly designed for it. Write for further information.

New CP-55 Diamond Drill has 25% more power

Basically similar to the famous CP-5, a newly designed rotary air motor gives the CP-55 Diamond Drill 25% more power without any increase in over-all weight.

Conservatively rated at 500 feet with E-EX fittings, the CP-55 is notable for: exceptionally fast drilling speed . . . light weight; only 160 pounds . . . abundance of power . . . ease of handling . . . minimum air consumption per foot drilled.

Designed for both coring and non-coring operations; blast hole couplings supplied when desired. Write for Bulletin 318.

Complete line of Sinker Drills

Chicago Pneumatic builds a complete line of Sinker Drills, for dry or wet drilling, ranging from the conveniently light CP-22 (28-pound) and the general utility CP-32 (45-pound) to the heavy-duty CP-60N (119-pound).

The CP-59 (55-pound) is especially suited for shaft sinking and other heavy work in hard formations. Its powerful air blow keeps even the deeper holes free from cuttings. With fast drilling speed and strong rotation, it also is outstanding for low air consumption per inch drilled. Write for Bulletin 850.

Modern Mining

CP ROTORdrifter has most efficient feed

The new CP ROTORdrifter — with a rotary motor built into the drill — offers these important advantages: shorter overall length . . . less weight . . . a single air hose . . . drill and feed controls both located in backhead . . . exceptional drill balance . . . smooth operation, with lessened vibration . . . minimum number of working parts . . . low upkeep. Two sizes: CP-50N of 3″ cylinder bore; CP-60N of 3½″ cylinder bore. Write for SP-2026.

For every demolition job

The new 35-pound CP-113, illustrated, completes the world's largest line of demolition equipment — ranging from the lightweight CP-111 (25-pound) to the powerful CP-118 (80-pound) for the heaviest kind of jobs. Request Bulletin 865.

For fast, easy drilling

Designed to provide fast and easy operation of the more powerful CP drifter drills, the lightweight G-200R Wagon Drill reduces drilling costs . . . drills holes at any angle. Main frames, uprights and mounting are of seamless tubing, providing maximum strength per pound of weight. The sliding cone, with a 36-inch adjustment, offsets ground irregularities or uneven steel lengths. Wheels can be turned at right angles for drilling close to the face. With roller bearing wheels and pneumatic tires it can be moved with ease over rough ground. The G-200R Wagon Drill is available with CP-50N (3″), CP-60N (3½″), or CP-70 (4″) Drifters. Write for SP-1980.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Screens 150–200 TPH, 10 Hours a Day for 7 Years

CAMPBELL LIMESTONE CO., Liberty, S. C. is mighty pleased with this 5 by 14 ft double deck *Ripl-Flo* vibrating screen installed for sizing granite, one of 8 *Ripl-Flo* screens installed here.

And no wonder! It's been on the job 10 hours a day for seven years, handling 150 tons per hour — sometimes as high as 200 TPH. Maintenance has been extremely low; sizing efficiency has been extremely good.

This case is *typical* of how *Ripl-Flo* screens have paid off for hundreds of stone plant operators — in long, dependable service . . . in reduced downtime . . . in *profitable* performance!

CHECK IMPORTANT FEATURES

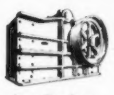
Ripl-Flo's smooth, circular motion to every point on screen surface gives you rapid stratification with no "dead spots" anywhere on screen.

Allis-Chalmers' method of providing adequate, uniform support for the screen surface increases cloth life. Convenient clamping plates make it easy to change cloth surfaces. *Ripl-Flo* screens are built with only two bearings to lubricate instead of four. Less weight; less width — lower power costs; lower maintenance expenses. Simplified design makes possible lower first cost, too!

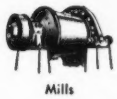
The A-C representative in your area can show you how *Ripl-Flo* screens may help you save big money on your job. Call him today, or write for *Ripl-Flo* screen **Bulletin 07B6151B.** Allis-Chalmers offices or distributors in principal cities in the U. S. A. and throughout the world.

A-2654

Kilns, Coolers, Dryers


Jaw Crushers

Hoists


Mills

Gyratory Crushers

Vibrating Screens

AND OTHER EQUIPMENT FOR THE CRUSHING, CEMENT AND MINING INDUSTRIES

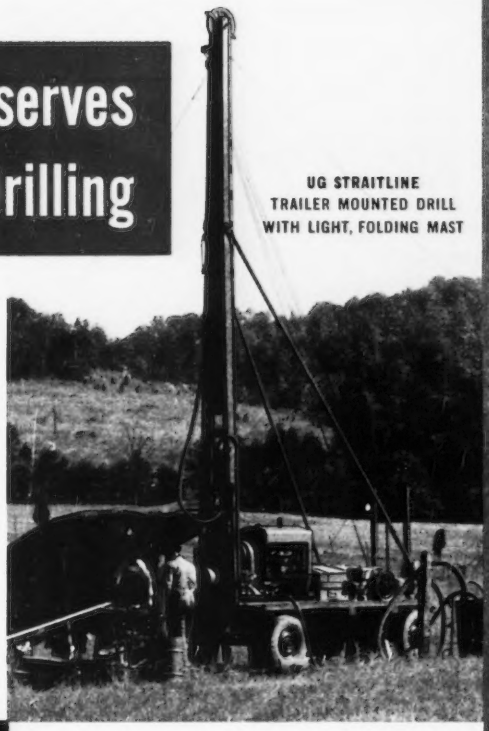
ALLIS-CHALMERS, 969A SO. 70 ST.
MILWAUKEE, WIS.

A-C ALLIS-CHALMERS

Ripl-Flo is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Increase Mineral Reserves By Diamond Core Drilling

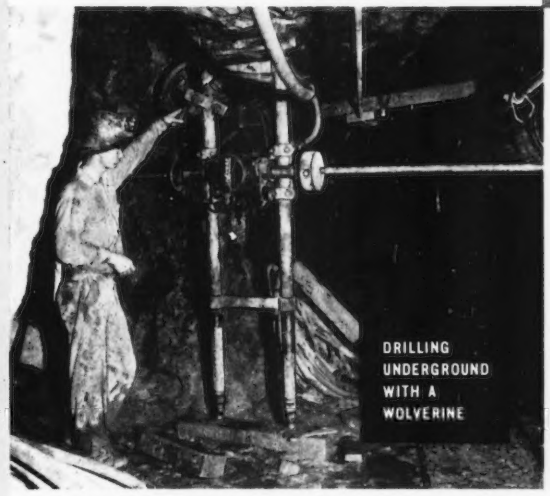


UG STRAITLINE
TRAILER MOUNTED DRILL
WITH LIGHT, FOLDING MAST

● Rich orebodies become worked out. Even reserves, once adequate, are dangerously low in many cases, yet the long term demand for minerals increases.

How is this challenge to be met? First of all, new deposits must and can be found by systematic exploratory search. Second, every effort should be made to expand present reserves.

The LONGYEAR organization will help you to accomplish the above objectives. It will supply you with drills suited to your job, or it will do your drilling under contract, if you prefer.



DRILLING
UNDERGROUND
WITH A
WOLVERINE

CORE DRILLING ON CONTRACT. In contracting your drilling to **LONGYEAR**, you gain the following advantages:

WITHOUT INVESTMENT *on your part, modern LONGYEAR core drills and equipment are available for your drilling projects.*

EXPERIENCED CREWS, *using the latest drilling techniques, carry out your exploratory program in accord with your wishes.*

YOU ARE PROVIDED *with accurate samples, most essential factors in your mineral search.*

DIAMOND CORE DRILLS. LONGYEAR manufactures a complete line of diamond core drills and equipment.

LIGHTWEIGHT, *easily set up machines are built for underground use.*

STURDY, *mobile equipment is available for rapid surface exploration.*

POWERFUL DRILLS *are made to meet the requirements of deep hole drilling.*

● CONSULT US ON THE PROBLEM OF INCREASING YOUR MINERAL RESERVES

E. J. LONGYEAR COMPANY

MINNEAPOLIS, MINNESOTA, U.S.A. NEW YORK OFFICE, 1775 BROADWAY

CANADIAN LONGYEAR, LIMITED, NORTH BAY, ONTARIO, CANADA

DIAMOND CORE DRILLS • CONTRACT CORE DRILLING
SHAFT SINKING • GEOLOGICAL INVESTIGATIONS

REPRESENTATIVES IN PRINCIPAL MINING CENTERS IN THE UNITED STATES AND OTHER COUNTRIES

NOW MORE THAN EVER

SPECIFY BWH

ORE PRODUCTION EQUIPMENT

Today, many mine operators are squeezed between mounting operating costs and tightening markets. The reduction of many deposits to low grade ore has meant extra handling, and very definitely requires close figuring of operating costs to keep out of the red. That's why it's important to investigate BWH equipment, which is designed to add capacity and improve efficiency on most basic mining jobs.

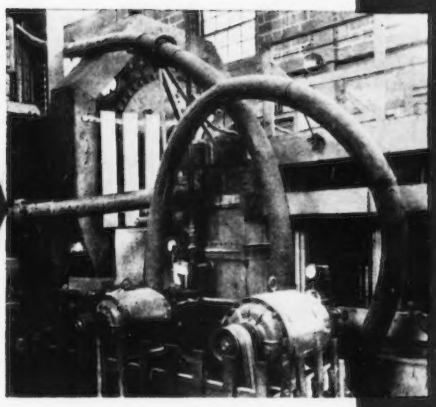
BWH DEPENDABLE RUGGEDNESS

BWH CONVEYOR BELTS

Reduce Per-ton Handling Expense

BWH Conveyors are the only belts made by the modern ROTOCURE process of continuous vulcanization, which eliminates potential trouble spots caused by press overlaps in flat press curing. As a result, BWH Conveyor Belts haul heavier loads for longer periods, resist the clawing and biting of jagged materials, stand up under grueling abuse. Look at the records! You'll find it pays to specify BWH Belts for greater tonnage and lower maintenance costs.

ORE HOSE

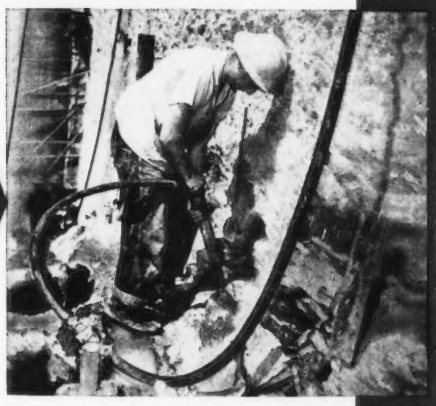


BWH ORE HANDLING HOSE

For Conveying Ground Ore at Low Cost

Specially engineered to handle highly abrasive materials, BWH Ore Handling Hose combines strength and high flexibility. Multiple plies of heavy duck are laid over a tough, wear-resistant rubber lining, ½" thick and upward as specified. Wire reinforced for suction, or nonwire reinforced for discharge. A high grade, age-resistant rugged rubber cover encloses both tube and carcass. Outside sleeve-type fittings eliminate contact with abrasive ore and thereby prolong service. Used to carry ore to and from the refining hoppers and for other tough jobs, BWH Ore Handling Hose pays off in extra-long, extra-economical service.

AIR HOSE

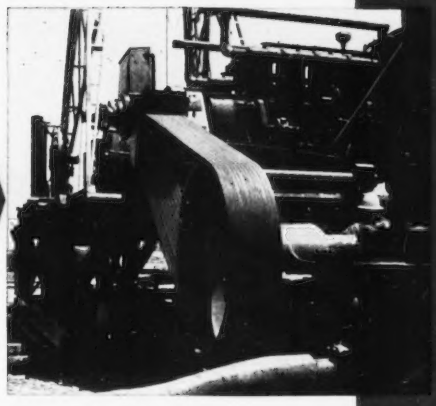


BWH AIR DRILL HOSE

Pays Its Way on Mining Jobs

Operators find it pays to use BWH "Bay State" wherever air drill hose is needed. The tube of this famous hose is made with the highest quality extra-heavy rubber, able to withstand the deteriorating action of hot oils. Carcass consists of multiple plies of strong duck, bonded with long-life friction. Tube and carcass are encased in a stout rubber cover designed to resist surface damage, shocks from falling rocks and constant banging against rough surfaces. "Bay State's" trouble free performance means no costly delays on the job, lower labor costs, and increased production.

V-BELTS



BWH BULL DOG V-BELTS

Help to Slash Maintenance Figures

In every industry where steady, dependable, low-cost power is a basic need, Bull Dog V-Belts are increasingly in demand. The exclusive Bull Dog cord section has higher tensile strength, and the cords are processed in a new way which results in less slippage, fewer adjustments, and longer belt life. These V-Belts run cool, don't crack or deteriorate under severe flexing. Bias-cut heavy fabric covers protect the heart of the belt from dirt, grease and moisture. Bull Dog Fractional Horsepower (FHP) and Industrial V-Belts have exceptional capacity for long, trouble-free, economical service.

HAVE YOU A JOB WHERE STAMINA COUNTS?

Bring us your toughest problems. We're specialists in solving them. Consult your nearest BWH distributor or write us direct.

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all Principal Cities

PLANT: CAMBRIDGE, MASS., U.S.A. • P.O. BOX 1071, BOSTON 3, MASS., U.S.A.

Increase Production of Fines by 300% with

STURTEVANT
Centrifugal Air Separators

ACCURATE SEPARATION OF FINES FROM 40 TO 325 MESH AND FINER... OUTPUT CAPACITY FROM ¼ TO 50 TONS PER HOUR

Records prove that Sturtevant Air Separators cut separation costs of various materials by as much as 300%. In addition, they provide additional economies by reducing power costs up to 50%. That's why you'll find hundreds of these efficient separators in all types of industries.

Ruggedly constructed of quality materials, Sturtevant Air Separators keep on working day after day with minimum maintenance. They are available in many sizes from ¼ to 50 tons per hour output.

Investigate cost-cutting Sturtevant Air Separators for your plant. Write for catalog and information, today.

STURTEVANT MILL COMPANY

101 Clayton St., Boston 22, Mass.

Designers and Manufacturers of

CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS
MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

GET THESE

2 BIG SAVINGS..

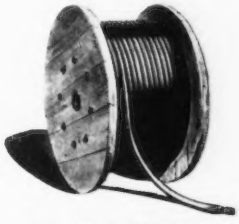
ON POWER CABLE

1 Power cable with Alcoa E.C.* Aluminum conductor costs far less than copper —as little as half as much, in larger sizes.

2 Aluminum cable of equivalent current-carrying capacity weighs far less than copper. You need fewer men to install it; you need less costly supporting structure.

Alcoa makes light, strong, conductive E.C. Aluminum which leading wire manufacturers draw, strand and insulate and sell under their own trade-marks. They have it in all popular sizes with insulations that withstand mine waters. Ask your wire supplier about it, or write ALUMINUM COMPANY OF AMERICA, 1476G Gulf Building, Pittsburgh 19, Pennsylvania.

*E.C.: *Electrical Conductor* Aluminum



The BIG DIFFERENCE is in your COSTS!

ALCOA EC ALUMINUM

FOR ELECTRIC WIRE AND CABLE

to serve the mining industry now . . . and in the future . . .

NEW

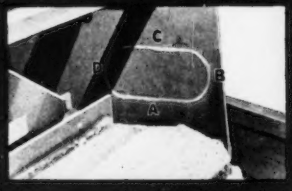
a major advance in the mechanical refinement of classification units

the Dorr TYPE H Classifier

THE DORR TYPE H STROKE . . .

◀ Chalk marking the rake path of a duplex Dorr HX Classifier in shop demonstration.

Type H Classifier rake path ▶ chalked on side of tank. Note flat raking and return strokes (A and C) and elliptical raising and lowering strokes (B and D). Regular pattern of rake path shows how rakes are synchronized both horizontally and vertically and balanced at all times.



Bulletin #2281 gives complete information on this radically different unit. Write for your copy now . . . or better still, have a Dorr engineer show you what the superiority of Type H design means in terms of your own operation. No obligation, of course.

Incorporating an entirely new and radically different headmotion design and rake path, the new Dorr Type H Classifier line represents a major step forward in the mechanical refinement of classification units. It offers many definite advantages over its predecessor, the Type F . . . yet retains all the features which have made the Dorr Classifier an accepted standard throughout the world.

Simplicity is the keynote of Type H design. It has few moving parts and the simplest Classifier lubrication system yet devised. It employs a fully harmonic raking motion and a long, full-load raking stroke. It is equipped with a hydraulic lift mechanism that provides more than 12 inches of rake lift in the pool. It is designed for work . . . for high efficiencies and low operating cost.

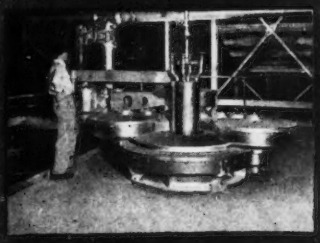
DORR EQUIPMENT *and* TECHNIQUES . . .

NEW **THE DORR TYPE PL (Parallel Lift) HYDROSEPARATOR . . .**

for extra-heavy duty operation where units of 100' diameter and larger are required in phosphate rock, sand, coal or any field where the going is really tough. Parallel torque lift with integrated hydraulic lift . . . 800,000 foot pound torque drive . . . triangular construction throughout.

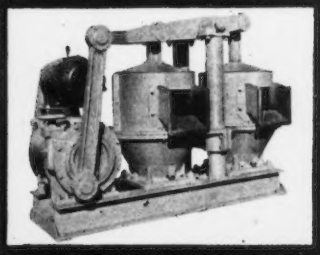
NEW **DORR TYPE H HYDROSEPARATORS AND THICKENERS . . .**

for heavy duty operation where units of 50' to 100' diameter are required to handle large tonnages of granular solids. Automatic hydraulic lift activated by torque load . . . free, center cone discharge . . . heavy duty drive . . . triangular construction throughout.



NEW **DORR SLURRY MIXERS WITH TYPE H DRIVE . . .**

for large volume kiln feed storage required in modern cement production. Center shaft mechanism requires no center pier and foundation, greatly simplifying tank construction . . . extra power in Type H drive . . . proven rake and air lift principle . . . available in 45' to 70' diameter range.



NEW **THE DORRCO TYPE W PUMP . . .**

a rugged giant designed for use where big tonnages, big flows or heavy pulps must be handled. Six to one stroke adjustment while running . . . single 8" duplex unit handles up to 75 cubic feet per minute . . . minimum lubrication . . . high mechanical efficiency.

THE DORRCO FLUOSOLIDS SYSTEM . . .

a new tool for the thermal reaction of solids through the use of fluidization. Commercially proven for the roasting of pyritic gold concentrates and other sulphide concentrates or intermediates . . . for the calcination of limestone and various other compounds. Reburning of lime sludge, magnetic roasting of iron ore and many other applications nearing final stages of development.

THE DORRCO FLUODRY SYSTEM . . .

for the drying and/or classification of coal, sand, limestone, non-metallic minerals and other such granular or crystalline materials.

THE DSM CYCLONE . . .

a compact cylindro-conical classification unit utilizing centrifugal force in place of gravity. applicable where hydro-separation or micron classification is required in fields other than heavy-media separation.

DORRCO WORLDWIDE

Throughout the mining areas of the world, Dorr equipment and engineering are available through Associated Companies and Representatives, with facilities for local manufacture.

IN EUROPE: Dorr-Oliver Companies in England, Belgium, Netherlands, France, Germany and Italy.

IN SOUTH AFRICA: E. L. Bateman, Pty., Ltd., Johannesburg.

IN AUSTRALIA: Hobart Duff, Pty., Ltd., Melbourne.

IN THE PHILIPPINES: C. W. Burgess, General Engineering Representative, Baguio.

IN SOUTH AMERICA: Fiore Company in Buenos Aires, Serva Ribeiro in Rio de Janeiro and Sao Paulo, and conveniently located Dorr Resident Engineers.

DORRCO

THE DORR COMPANY, ENGINEERS
570 LEXINGTON AVE., NEW YORK 22, N. Y.
ATLANTA • TORONTO • CHICAGO
DENVER • LOS ANGELES
RESEARCH AND TESTING LABORATORIES
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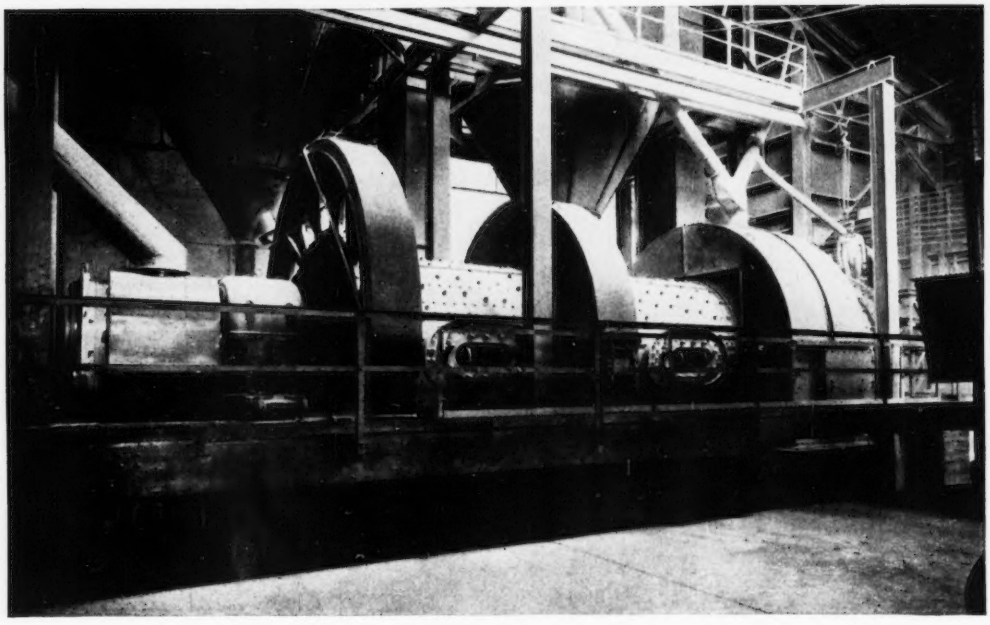
SUGAR PROCESSING
PETREE & DORR DIVISION, NEW YORK 22, N. Y.
ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

CHEMICAL ENGINEERING EQUIPMENT



Grinds 6,000,000 Tons in 19 Years: 16-20 Hours a Day

TAKES REAL TOUGHNESS to stand a long grind like this. Yet, after 19 years, this 9½ ft diameter, 3-compartment dry grinding *Compeb* mill is still going strong for a large cement company.

On the job 16 to 20 hours a day, this Allis-Chalmers mill reduces limestone and shale to a specification raw mix for a rotary cement kiln. Aside from routine liner and grinding media replacement, the mill has required only *one major repair,* a pinion and pinion shaft.

CHECK THESE STRENGTH FEATURES

Strength and stamina are built into every part of Allis-Chalmers *Compeb* mills.

- Bearings, for example, are extra large and equipped with flood lubrication . . . your assurance of low bearing pressure, long life.
- Mill shells are of all-welded construction, "stress-relieved" after welding to minimize strains.
- Mill heads are designed for maximum strength per pound of metal used.

CHOOSE FROM 5 MILL TYPES

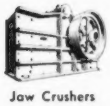
When you specify Allis-Chalmers for grinding mills you'll get a mill that's *well-suited to your specific grinding job.* A-C builds five separate types of grinding mills in a maximum range of sizes . . . with overflow, diaphragm grate or special discharge modifications . . . with feeder and drive to suit your mill size and application.

For sound advice on your grinding problems — based on A-C's experience in building *over 4,000* mills—call your nearby A-C representative. Offices or distributors in principal cities in the U.S. and throughout the world.

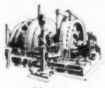
Compeb is an Allis-Chalmers trademark.

A2672

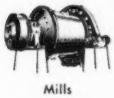
Kilns, Coolers, Dryers



Jaw Crushers



Hoists



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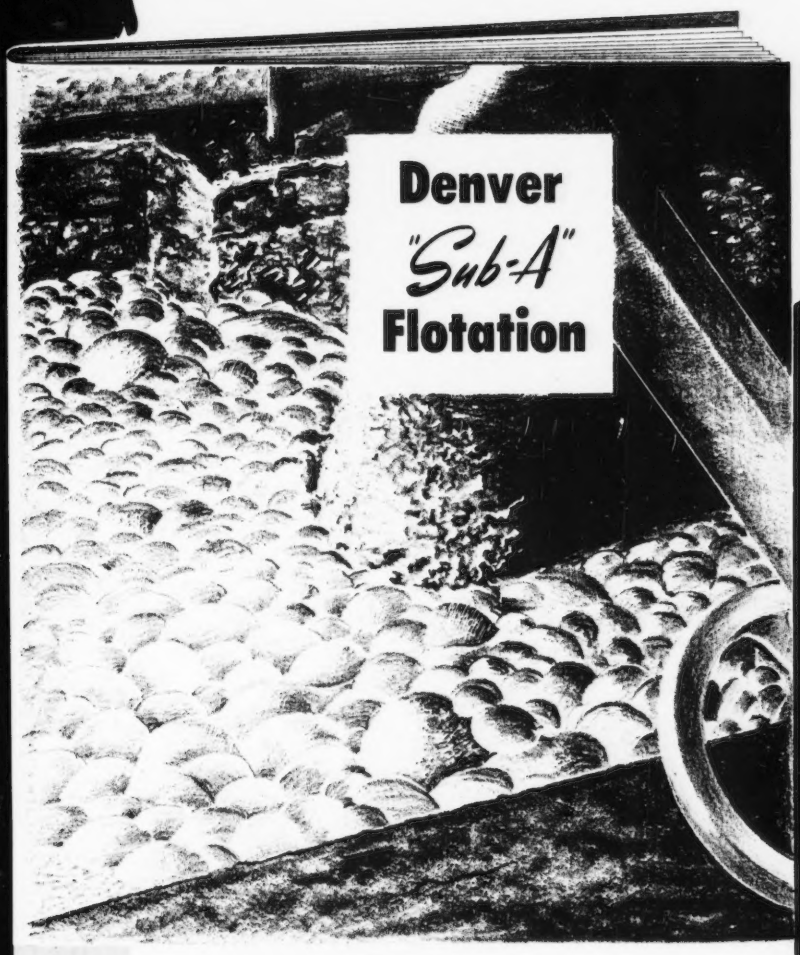

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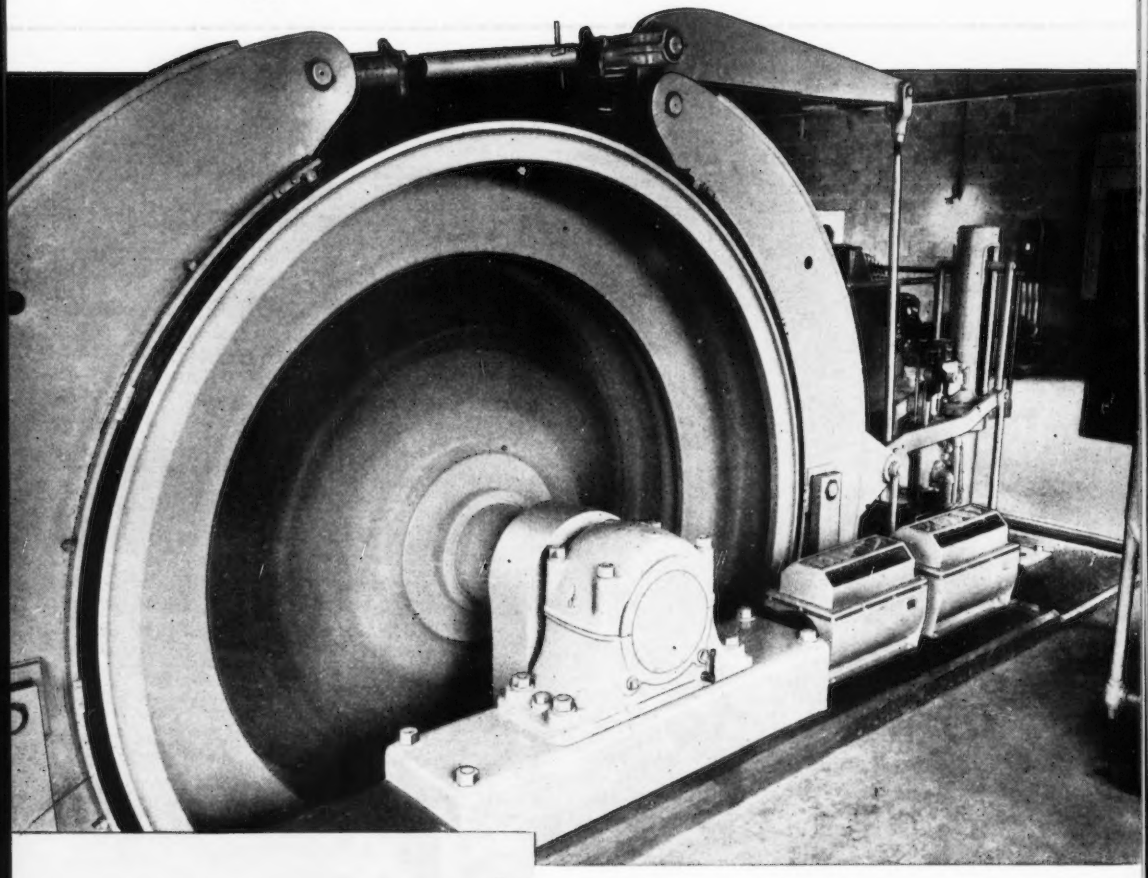

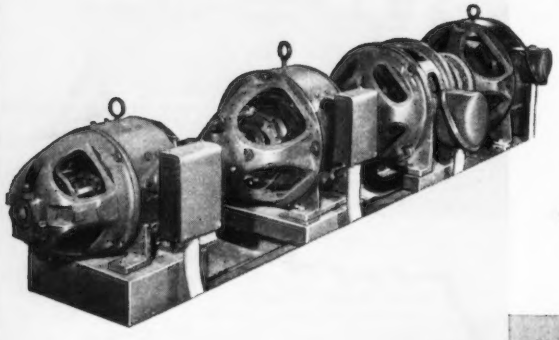

"Operatorless operation" is provided by this new Westinghouse-equipped Automatic Hoist installed in the Green Valley and Wabash Mine of the Snow Hill Coal Corporation. After the hoist is placed in operation at the start of a shift, the automatic control provides continuous hoisting. It moves coal from the hopper onto the weighing pan, fills the skip, travels it upward, dumps it and returns it for another load. The cycle is repeated indefinitely until stopped, or until there is no coal left in the hopper.

These Rototrol rotating regulators provide the "judgment" for automatic control. They assure uniform time cycles of preset duration, smooth stopping and accurate positioning of the skip at the loading pocket and on the dumping horns.

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This Automatic Hoist is the latest addition to the complete line of Westinghouse drives for coal, metal and nonmetallic mine hoists. It is one more example of how Westinghouse co-ordinated engineering meets the need of the mining industry *for more tons per man-hour.*

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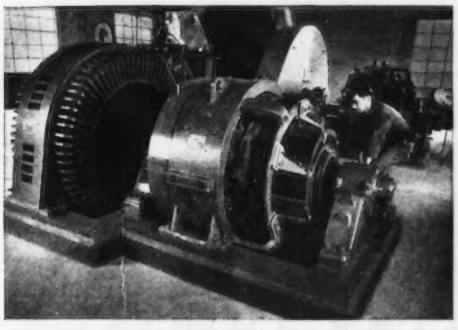
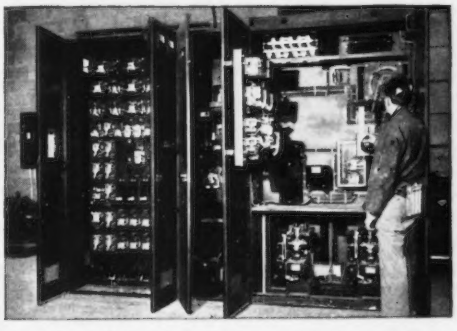
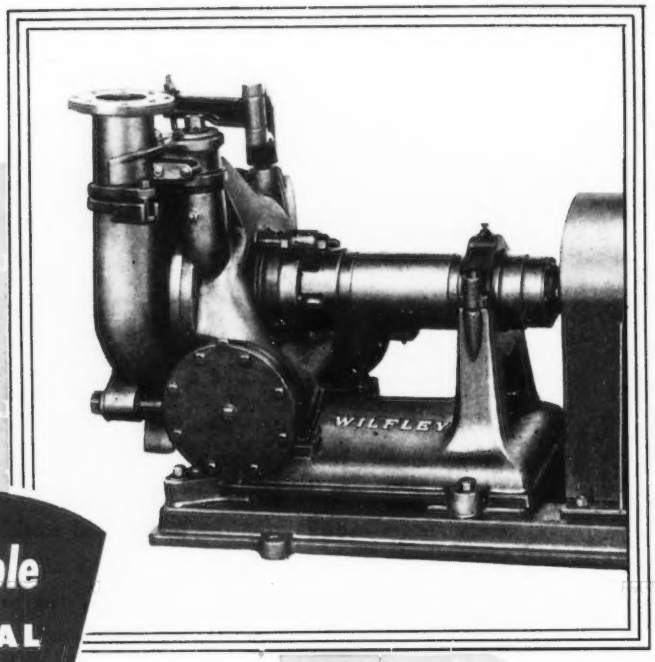


This 1000-kw, 720-rpm synchronous motor-generator set supplies power for the automatic hoist. In the background may be seen the 1250-hp, 450-rpm, d-c motor and the cylindro-conical cable drum with maximum rope speed of 2485 fpm.



The control center unit provides two types of control. (Left) The relay board, containing relays, circuit breakers and contactors, gives automatic operation. (Right) When desired, the operator can operate hoist manually for inspection.



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ENGINEERING AND MINING JOURNAL

JULY, 1949

MINING LOOKS TO THE FUTURE

NOTHING THAT CAN HAPPEN during the present period of readjustment can hide the challenge the mining industry inevitably must face.

First, the security of the nation in war, and its industrial prosperity in peace, depend absolutely on mining and its products.

Second, mining lives only as long as its orebodies, for there is only one irreplaceable crop of minerals in any one deposit. Mining must constantly expand and renew its sources of supply, or it ceases to exist.

Is free enterprise in the mining industry equal to that challenge as it is presented today? The feverish demands that only months ago strained every productive fiber of the industry have gone. Can the nation then depend on mining men to look beyond the uncertainties of today to the future, when the urgent demand will be renewed?

This issue of *Engineering and Mining Journal* provides the answer. In these pages you will see that the mining industry, *your* mining industry, has done, and will continue to do, its magnificent best to see that future mineral supplies are adequate. Briefly, the job has been done:

1. *By finding new orebodies,* as Hanna and Hollinger in Labrador, San Manuel in Arizona, and Calumet & Hecla in Wisconsin.

2. *By re-developing old mines,* as Walter Scott at Silver Plume, or the "new" Arizona open pits.

3. *By technological improvements,* that turn waste rock into ore, like taconite treatment, or the Greater Butte Project's adaptation of mass mining.

4. *By building new plants,* as Chuquicamata in Chile, Kennecott in Utah, the Bradleys in Idaho, and A. S. & R. in Texas.

5. *By joining with foreign companies,* as Zellidja and Tsumeb in Africa were formed.

6. *By producing "new" metals,* and helping to find uses for them, like titanium or uranium.

To carry out these projects, and hundreds of others, many of which are described in this issue, the mining industry has pledged, or planned, an investment totaling about half a billion dollars.

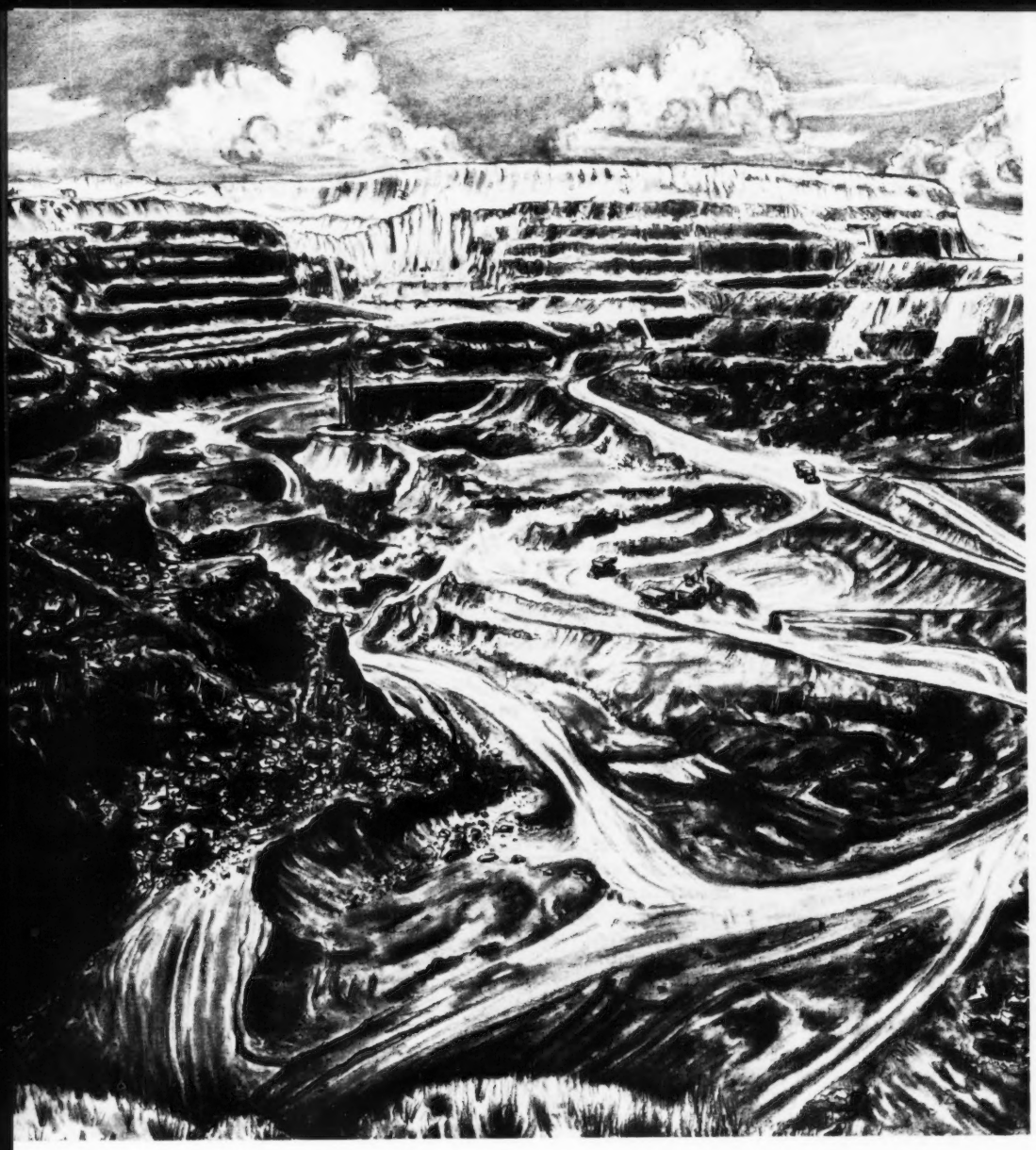
Yet only a few months ago, many in Government, President Truman among them, criticized the mining industry for the alleged inadequacy of its productive facilities. Here in these pages is the industry's answer, proof of the vigorous growth that the nation must demand of mining.

Remember, moreover, that all these projects were planned in the face of discouraging tax burdens, and that they are now being carried forward under the added deterrent of falling metal prices.

America can be thankful, indeed, that these mining companies now have both profits and the courage to spend them to provide for the new mines, the plants, the vital new jobs of the future. Impressive as they would be at any time, how much greater loom the industry's accomplishments against the handicaps they have overcome.

Mining, as it looks to the future today, can indeed take pride in a difficult job well done.

★ ★ ★



The Problem of Iron Ore . . .

A. H. HUBBELL
Managing Editor

SUPPORTING AMERICA'S ECONOMY, its industrial greatness, and its status as a world power is its iron and steel supply. The maintenance of dependable sources of iron ore for the steel industry is therefore a matter of prime national importance.

Ore supply for today's requirements is ample. That for the future needs attention now. War and postwar demands have made heavy inroads upon reserves.

The burden has been assumed by interests already engaged in mining ore and making steel. In this, as in its wartime achievements, private industry has acted effectively for the country's future well-being and its own.

Pertinent questions arise. Will steel continue to be essential? No substitute has appeared that seems likely to replace it in any relatively important tonnage.

How far shall we look ahead? Much can happen in fifty years. At the same time, if the industry can hedge against the future by assuring itself of ore resources for a much longer period, so much the better.

What about national defense? Much speculation is involved. Shall we stockpile ore or metal, or create a reserve ready for quick mining? Whatever we set aside from reserves makes the remaining tonnage that much smaller.

Present Ore Supply

Steel making is centered in the Great Lakes area. Here is found 80% of the nation's furnace capacity. The reason lies in the availability here of the necessary raw materials —iron ore, coking coal and flux—plus transportation. Here also are most of the country's plants making heavy machinery and equipment. This central Great Lakes area has been called America's industrial heart.

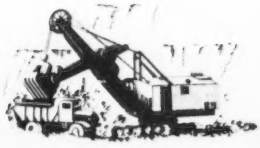
Iron ore from the Mesabi, in the main, has supplied these furnaces. From its open pits high-grade ore has been shipped direct. Also from the Mesabi have come increasing tonnages of poorer ores, likewise easily mined but requiring simple beneficiation. Other ranges likewise have contributed their ores, most of them mined underground. The sole source outside the Lake Superior region for these furnaces has been the Adirondack area in New York.

What Is Left on the Mesabi?

Heavy wartime and postwar demand was met most quickly from the Mesabi pits. The tonnage of high-grade, direct-shipping ore still remaining will vary with the individual company. Considered in proportion to annual requirements, it will last less than five years for some shippers and somewhat less than a quarter century for the company having the largest tonnage.

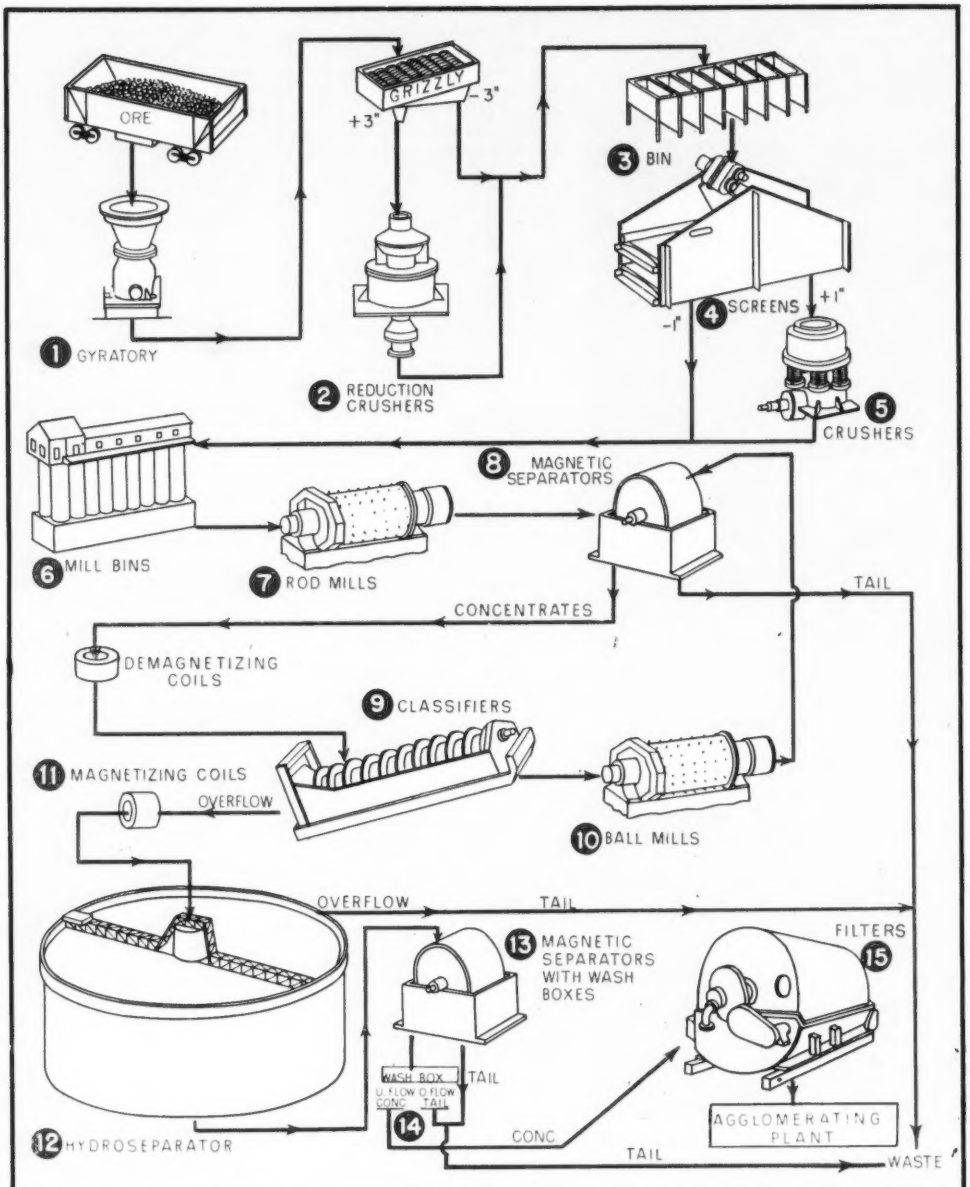
Reserves of direct-shipping ores and concentrates on the Mesabi from both open-pit and underground, allowing for new ore added during the year, amount to 1,271,300,000 tons as of Jan. 1, 1948, according to one conservative estimate. With annual shipments from the Mesabi at their maximum pre-war rate of about 46 million tons, the remaining life of the range would be approximately two decades and a half. Other estimates are larger. One puts the life

. . . and How It Will Be Solved



From its huge open pits, the Mesabi still amply supplies industrial demands for iron ore, yet mining men must look ahead to the day when new sources of ore must be provided

Flowsheet developed by Reserve Mining Co. for concentrating magnetic taconite



LEGEND

1 One 60-in. gyratory
2 Two 24-in. reduction crushers
3 Surge bin, 6,000 tons
4 Four 5x8-ft. vibrating screens
5 Four 7-ft. Symons Short-Head crushers
6 Mill bins, 42,000 tons
7 Eight 9½ x 12-ft. rod mills
8 Sixty-four single-drum magnetic separators
9 Sixteen 54-in. Akins classifiers
10 Sixteen 9½ x 12-ft ball mills
11 Sixteen direct-current magnetizing coils
12 Sixteen 22-ft. dia. Hydroseparators
13 Forty-eight single-drum magnetic separators
14 Forty-eight wash boxes
15 Filters over storage bins

of the Mesabi at three to four decades, with a gradual decline after that time.

If a future war be considered, obviously the Mesabi cannot be depended upon again as a source for quick supply. If peacetime requirements be pondered, even three or four decades of remaining active life seems a short period in the nation's history. The provision of new sources is therefore essential.

Never again will Great Lakes furnaces get iron ore comparable to the high-grade Mesabi ores as cheaply as these have hitherto been supplied. This cheapness has been due in part to a taxing policy which tended to force the ores on the market. Large-scale, highly mechanized surface mining also has given a low operating cost per ton. The Lake Erie price for Mesabi non-bessemer was $4.45 throughout the war, rising to $4.55 at the end. Subsequent advances have brought it to its present level of $7.20 per gross ton at lower lake ports. Of this amount the shipper gets $4.71 for operating and other costs, including taxes, and any profit, after paying the rail and water freight.

The New Sources

Where will the iron ore come from in the future? The most promising source in point of nearness combined with huge tonnage is right at home in Minnesota. This is the taconite of the Mesabi—the lean iron formation from which the range's deposits were produced by natural concentration. In the past it has not been classed as ore. It will require beneficiation.

Outside the Lake Superior region, the one large domestic reserve which has supplied some furnaces in the Great Lakes area is that of the Northeastern magnetite district. From it, high-grade concentrates made from low-grade ores have been shipped. Its deposits are widely scattered and it has not been fully explored. Shipments undoubtedly can be increased from the Adirondack area.

Sources outside the United States also will be tapped. Ores from Venezuela will soon be coming to furnaces on or near the Atlantic seaboard. In time, they will find their way further West. The recently found resources of Labrador and New Quebec can be made available in about five years. In each of these regions, the prospective tonnages are huge.

Iron from Mesabi Taconite

THE PROPOSAL to make merchantable concentrates from Mesabi taconite is attractive. The concentrates would be richer than the high-grade and a better product physically. Any dislocation of the industry that might otherwise result from a deficient ore supply would be avoided. There would be no transport problem. National security would be unimpaired.

Life of the range communities, too, would be left unchanged. The threat of becoming ghost towns would be removed. Mines and plants would require even more labor than is used today. Tax revenues would be smaller, but would continue longer. All in all, the advantages to be derived from taconite beneficiation would be considerable.

In respect to tonnage, taconite as a source of iron is more than adequate. One variety has the iron in the form of magnetite, another in the form of hematite. The quantity of the former alone has been estimated to be enough for making 1.7 billion tons of concentrate. This is more than the entire Mesabi production of high-grade ore up to the present time.

Recovery Feasible

Is it possible to recover the iron from taconite at a reasonable cost? Engineers who have worked on the problem for years are convinced it is. Certain problems remain.

The idea of getting iron from taconite is not new. In the early 'twenties and previously it had received attention. D. C. Jackling had led the way. Test work led to the erection of a plant by the Mesabi Iron Co., at Babbitt, on the eastern Mesabi. Though this enterprise failed, the plant still stands as a monument to those that ventured with it. In this early work and subsequently the Mines Experiment Station at Minneapolis, under E. W. Davis, played an important part. Mesabi Iron's property is now under long-term lease to Reserve Mining Co. and plans for a new plant have been made.

Lower Taxes Stimulate

An easing of the prospective tax burden was effected in 1941, when a new law for taconite was passed providing for a tax of 6c. per ton of beneficiated product, payable only when shipped. Stimulation of interest in taconite as a commercial source of iron was the immediate result.

Beneficiation is getting much study. The Experiment Station has long been on the job. Several laboratories have been set up, including those of the Oliver, Hanna, Jones & Laughlin, and Cleveland-Cliff's companies, also one built by the State of Minnesota at Hibbing. That of Pickands, Mather & Co. has been in service longer. In addition, the Battelle Institute has been engaged in cooperative research.

In mining taconite, it will be broken and loaded in open pits with the usual equipment, save that jet-piercing rigs will probably be substituted for churn drills for making blast holes.

The over-all beneficiation problem is complex, according to Dr. Davis. Taconite is not a simple material of constant uniform composition. It has been defined as a hard, compact, siliceous rock, 25-35% in iron, that varies widely in chemical composition and in the nature and distribution of its iron content. Fine grinding is necessary to unlock the particles containing the iron. Grinding to minus 200-mesh is usually sufficient for the magnetic variety.

There are several types of magnetic taconite on the Mesabi. Each has its own characteristics, requiring a slight modification of the flowsheet. In general, each requires a flowsheet comprising crushing, fine grinding, magnetic separation, dewatering and agglomeration.

Two Pilot Plants at Aurora

At Aurora, the Erie Mining Co.'s pilot plant (managed by Pickands, Mather) for concentrating magnetic taconite and pelletizing the concentrate, has been in commission about a year. Its capacity is 200,000 tons per year of finished product. Cost is reported to have been about $2 million. The initial full-

scale plant for operation will make 2½ million tons of finished product at the start. Back of this project are the Bethlehem and Youngstown companies.

Iron in taconite may also occur in carbonate form. A large-scale pilot plant to make iron powder from carbonate has also been erected at Aurora, with funds appropriated by the State of Minnesota. In charge is Continental Machines, Inc.

The Reserve Company's Project

Reserve Mining Co.'s proposed plant will be at Beaver Bay, on Lake Superior. The company's taconite reserves are thought to justify a capacity eventually of 10 million tons of finished product per year, equivalent to 30 million tons of crude. Planned to have four units, the plant could be built one or two at a time. Included also are a power plant, a 48-mile railroad, a new harbor. Construction awaits the completion of financing.

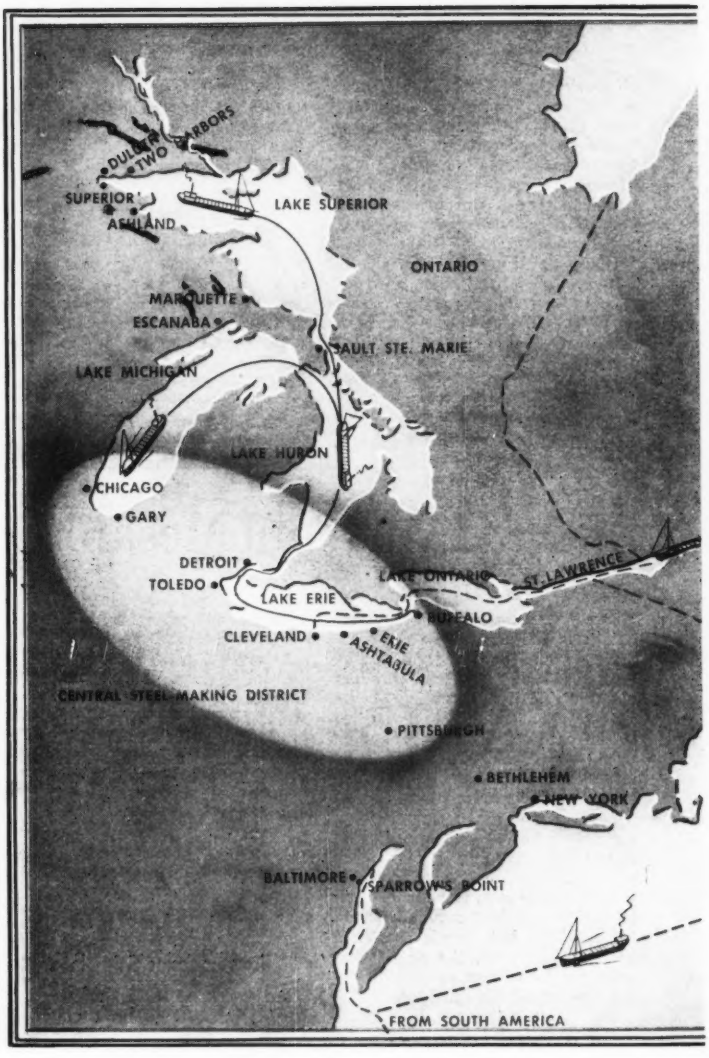
The proposed flowsheet, shown on page 86 and based on one by H. K. Martin, calls for grinding to 85% minus 325-mesh. A concentrate running about 64½% in iron would be made, with 90% recovery of magnetic iron.

Agglomeration by pelletizing should be cheaper than sintering, it is thought. To decide this, Reserve stockholders have built a pilot plant for pelletizing at Ashland, Ky. Cost is put at $1 million. Using 67% Adirondack concentrates, it is expected to make 60,000 tons of pellets the first 12 months for testing at furnaces of Armco Steel, part owner of Reserve. Wheeling Steel Corp. also shares in this enterprise.

Capital expenditure will be big for the large-scale production plants. Estimated cost for plant and mine has risen to $10 per ton of annual finished product. Where a railroad must be provided and a harbor with port facilities, as at Beaver Bay, the figure is put at $15 per ton.

When Will Production Start?

Uppermost in many minds is the question, when will production of iron from taconite on an industrial scale begin? The answer is, the time element is unknown, but the new development is surely on the way. If undertaken immediately, construction of a large-scale plant with all accessory facilities will probably take several years. Such work might be speeded up considerably, no doubt, if a crisis calling for a large production of iron ore were at hand.



Labrador Iron Ore

NEAREST IN MILES to the furnaces of the Great Lakes steel-making area of all important iron resources outside the United States are the recently found iron deposits of Labrador and New Quebec. It is little exaggeration to say that this new field is almost at home. For wartime supply it would be second only to domestic sources.

Here approximately 324 million tons of merchantable iron ore which can be mined by open-pit methods has been shown to occur. Drilling of 25 deposits has proved 222,774,000 tons of this on the Quebec side of the boundary and 101,054,000 tons in Labrador. Eight known deposits are still to be drilled. The orebodies found are distributed along a length of 90 miles and a width of 15. With one or two exceptions they have been developed from surface showings.

QUEBEC
QUEBEC
LABRADOR
QUEBEC
SEVEN ISLANDS
SEAWAY
LABRADOR CAN COMPETE WITH THE MESABI IN SUPPLYING CENTRAL STEEL DISTRICT
Labrador Ores Must Travel:
By rail to Seven Islands 360 miles
By seaway to Cleveland 882 miles
Or by ocean to Baltimore 1,700 miles
Mesabi Taconite Concentrates Must Travel:
By rail to Duluth 92 miles
By lake to Cleveland 837 miles

Nearest Outside Source

Undoubtedly there are other ore occurrences. Those responsible for the field work to date are optimistic over the chance of finding more ore in the large area remaining to be explored. Although two-thirds of the new ore is in Quebec, geological conditions are as promising in Labrador, and the area favorable to ore occurrence is much larger. Previously, work was concentrated in Quebec because there the ore is found more easily, due to lighter overburden and sparser vegetation. This season (1949), 17 field parties will concentrate on geological mapping and prospecting. Most of this work will be in Labrador because of the time limit on the concession area.

Owners of this iron ore are the Hollinger Gold Mines, of Montreal, and M. A. Hanna Co., of Cleveland. Its majority interest gives control to the former. Through participation by Hanna, the management has that company's extensive iron mining experience available. Two subsidiaries look after operation. In Quebec, the subsidiary is the Hollinger North Shore Co.; in Labrador, the Labrador Mining and Exploration Co.

For many people, Labrador has been a name for frigidity and severity of climate. Conditions compare favorably, however, with those of the mining areas of northern Ontario and Quebec. They are little different from those prevalent on the iron ranges of Minnesota. Data recorded at the air transport subsidiary's weather station at Knob Lake, in the ore area near headquarters, are evidence.

Fahrenheit Temperatures
Knob Lake Airport

1948-1949	Max.	Min.	Mean
September	74.6	15.0	45.5
October	63.2	12.8	36.2
November	43.9	—11.8	21.3
December	32.8	—26.3	0.1
January	23.0	—38.2	— 9.7
February	13.0	—39.7	—13.9
March	33.1	—38.0	2.2

Planes operated by a subsidiary provide transport between the Gulf and the ore area. Six aircraft have made it possible to reduce freight charges and improve the service.

Large Investment Planned

Much money will be required. Investment planning is being done. Consumer participation has been considered. The operators must build a 360-mile railroad, develop power, equip a mine or two to start, provide a dock and other facilities. This will take around $200 million, according to the management.

To build and operate the 360-mile railroad between the ore occurrences and the Gulf of St. Lawrence a separate company has been formed. After careful study a route was chosen. It runs from Seven Islands, on the Gulf, up river valleys to a point at Wacouna Lake 1,950 ft. above the sea, thence north over fairly level ground to Knob Lake in the ore area. Location work is under way. The maximum adverse grade against loaded trains is not expected to exceed 0.2%.

Hydroelectric power is to be made at Eaton Canyon on the Kaniapiskau River. Here, it is estimated, 140,000 hp. can be developed at minimum flow, and over 400,000 hp. when adequate storage has been provided.

The investment of $200 million needed to make this northern iron ore available to the steel industry

is large. But the supply of high-grade ore it would insure, so far as such things can be insured today, is also large. The cost per annual ton will depend on output. If a production of 10 million tons a year be assumed, the cost per ton of annual output would be $20. A somewhat larger annual output would be necessary to give the $15 cited as the approximate maximum for financing iron ore beneficiation projects on the Mesabi.

Disposal of substantial tonnages annually in the United States is contemplated. This country is regarded as the only present market for large quantities. At the same time, the management has an eye to possible present and future needs of Canada and Great Britain. The latter already imports the ore needed for half its total iron production.

The Seaway

An unobstructed route via the St. Lawrence to lower lake ports would help tremendously in disposing of this ore in the central steelmaking area. The views of G. M. Humphrey, president of M. A. Hanna, on this controversial subject are interesting. He says: "The distance by water from Seven Islands to Erie, Pa., . . . is almost exactly the same as the distance from Duluth, as our Lake Superior ores now move. The entire distance . . . to any lake port is now available for transportation in our regular standard lake vessels except for about 90 miles of intermittent rapids. If these rapids can be made navigable . . . the ore can be moved economically and competitively to the central industrial districts of Canada and the United States."

"We are interested in the ownership of large reserve tonnages of Lake Superior iron ore. We are not unmindful of the importance of such reserves nor do we contemplate the early exhaustion of shipments from that district, but continuation of the declining trend of shipments of high-grade direct-shipping ore from Lake Superior is inevitable. Expensive underground mining must be increased, and even more expensive beneficiation processes must be developed to make a useful product from lower-grade Lake Superior reserves. They will be required as a source of iron-ore supply for the future, but they can best be supplemented by shipments of high-grade open-pit direct-shipping ore from Labrador and Quebec. . . ."

EASTERN VENEZUELA showing confluence of Caroni river and Orinoco. To the north is the Gulf of Paria where, at Puerto de Hierro, ocean carriers will load the ore for transport to Baltimore and other United States' points. Situation of El Pao mine is seen, also of U. S. Steel's exploration projects.

Venezuela's Iron Ore Coming Soon

SOUTHWARD 2,300 MILES from Baltimore, at present the East Coast's best port for ore handling, are Venezuela's high-grade iron-ore deposits near the mouth of the Orinoco. Here our two largest steel companies have gone in their quest for ore. Bethlehem Steel Corporation, as long ago as the early thirties, acquired rights for exploring a tract in the Piar district of the State of Bolivar. Today the enterprise it established at its own expense is rapidly nearing production. Bethlehem's investment is of the order of approximately $50,000,000. The U. S. Steel Corporation, through its Oliver Iron Mining Co. subsidiary, also is in the region.

Bethlehem, working through its subsidiary Iron Mines Co. of Venezuela, is developing a block of 16 concessions, known as the El Pao mines. This property is expected to yield as much as 2 million tons of iron ore annually at the end of the construction period. The ore, a hard, high-grade hematite, suitable for both blast furnaces and open-hearth steel furnaces, will be shipped to the United States to Bethlehem's eastern steel plants.

The El Pao mines are in an almost entirely undeveloped tropical jungle about 30 miles south of San Felix, a town near the confluence of the Orinoco and the Caroni Rivers, about 165 miles from where the Orinoco empties into the Atlantic.

From the mines, ore will be shipped to a port site, Palua, on the Orinoco near San Felix. Construction at Palua, now completed, includes storage pockets for 40,000 tons of ore, loading facilities, a diesel-electric power plant, water works, shops, warehouses, and a village for employees. Regular passenger and mail service is provided twice weekly by the Venezuelan Airlines, using an airport built by the company near Palua.

The Orinoco's water level has a seasonal variation of 40 ft. For this reason, the ore will be loaded into barges (holding 4,000 tons) from a conveyor that extends out over the river 400 ft. The end is high enough to allow the barges to moor under it regardless of the height of the water. The ore will drop from the conveyor directly into them. It will be taken to a point at tidewater on the Gulf of Paria that has been named Puerto de Hierro, and transferred to ocean-going ore carriers. This port will be able to handle 3,000,000 tons per year and upward.

Work is also under way on the construction of a town named El Pao at the mines. There there will be modern houses for 450 employees and families; also a hospital, a school, stores, water works, a telephone system, and facilities for employees' recreation and health. The mines are about 2,000 ft. above the Orinoco at Palua. Although the location is in the tropical region, the climate is pleasant and moderate.

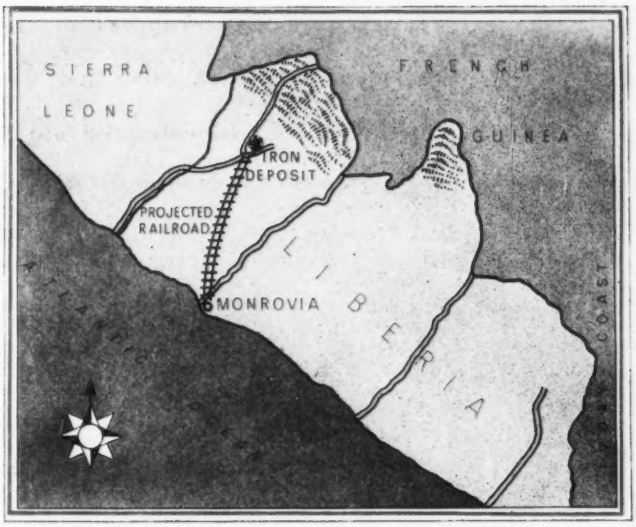
An improved highway and a 36-mile, standard-gage railroad connects Palua with the mines. The railroad should be in operation by the end of the year. There are three 130-ton, 1,500-hp. diesel-electric locomotives.

Both open-pit and underground mining are to be used. At the start, however, only the open-pit method will be employed. Electric shovels of 4-cu.yd. capacity will load 30-ton diesel trucks, which will haul the ore to the crushing plant. Facilities at the mines will include primary and secondary crushers, a diesel-electric power plant, warehouses, air compressors, repair and machine shops and general offices.

Recently about 1,250 men have been employed at the various sites, in addition to 350 men employed by the contractors.

U. S. Steel Explores

For two years past, U. S. Steel has been exploring extensively in the region south of the Orinoco's mouth by drilling in areas considered to have large deposits of iron ore. This is part of its world-wide investigation of iron ore occurrences. The corporation's policy is to examine all possibilities. It has concessions here on 75,000 acres for exploration purposes only. The areas are Piacoa Hill and La Grulla east of the tributary Caroni, and Cerro Bolivar, Rondon and Arimagua west of it. The results have not been announced.



IRON ORE DEPOSITS of Liberia Mining Co. are situated in Liberia about 45 miles northeast of the capital, Monrovia.

New Ore for Republic

A SUPPLY of lump iron ore has been secured by Republic by purchase of an interest in the Liberia Mining Co., in Liberia, Africa. This company, of which L. K. Christie, of New York, is president, has been developing properties 45 miles northeast of Monrovia, the capital.

The concession, granted to Mr. Christie and associates, contains a deposit of high-grade ore available at ground level. The ore is a mixture of hematite and magnetite, 68% in iron and low in phosphorus, sulphur and silica. It is found in hard masses which may be crushed into lumps for open-hearth charge and feed ore.

Development has been limited to the Bomi Hills area. Here there is a cliff-like exposure of ore extending a mile or more and 30 to 100 ft. above surface. A substantial tonnage has been revealed. More than 20 million tons of high-grade has been mentioned, with additional ore of lower grade.

Heavy expenditures will be required before production, including the cost of a 45-mile railroad between Bomi Hills and Monrovia. Terminals for handling a million tons a year will be completed in October. Shipments will begin in 1951.

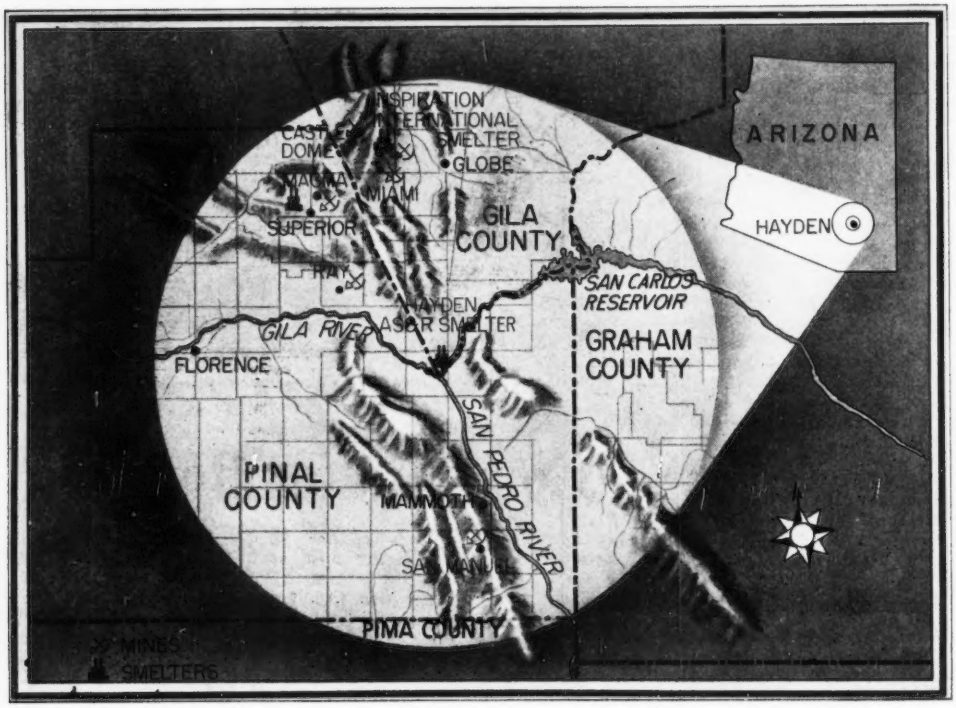
The Liberia company has borrowed $4 million from the Export-Import Bank to finance development, after getting $1 million from Republic also. An additional $3 million has been obtained from Republic on a long-term purchase agreement for part of the output.

Republic expects that this ore can be delivered to its steel plants in the central district and at Gadsden, Ala., to its advantage. From Monrovia to eastern U. S. ports is about 3,900 miles. The surplus will be marketed by the Liberia Mining Co. to the world trade.

CLOSE to its Chateaugay iron mine in the Adirondack magnetite area, in New York, Republic Steel Corporation has under development three new ore shoots containing over 13 million tons of proved ore and nearly 10 million of inferred ore. Like that in the Chateaugay vein, this ore is very low in phosphorus. Its iron content is higher, however. Like the other ore, it will be beneficiated before shipping. Belief holds that at depth the shoots join the Chateaugay orebody.

Development of the three new shoots will serve to replace the loss of output from the Chateaugay mine where operations are slowing down due to increasing rock pressure. At present mining is being done as deep as the 2,813-ft. level.

Where will tomorrow's copper come from? This question is answered firmly and amply on these and the following pages. America's reserves of ore and enterprise are far from being fully tapped



WITHIN A 40-MILE RADIUS of Hayden, Ariz., lies an area that is potentially one of the greatest copper producing districts in the world. Expansion of existing milling and smelting capacity, plus new discoveries of ore, promise a bright future for this mining region.

Our Most Promising Copper Area

Despite its more than 50 years of productive life, the area around Hayden, Ariz., which is spotlighted in the above map, begins to take on many of the aspects of a new mining region. New orebodies, like San Manuel, are being developed. Increased mill and smelter capacity is under construction. Field parties are out looking for more ore. Underground mines are turning to open-pit work to increase or supplement production. Potentially, the Hayden area ranks among the world's great copper districts. The following paragraphs on each of the area's copper mines show why.

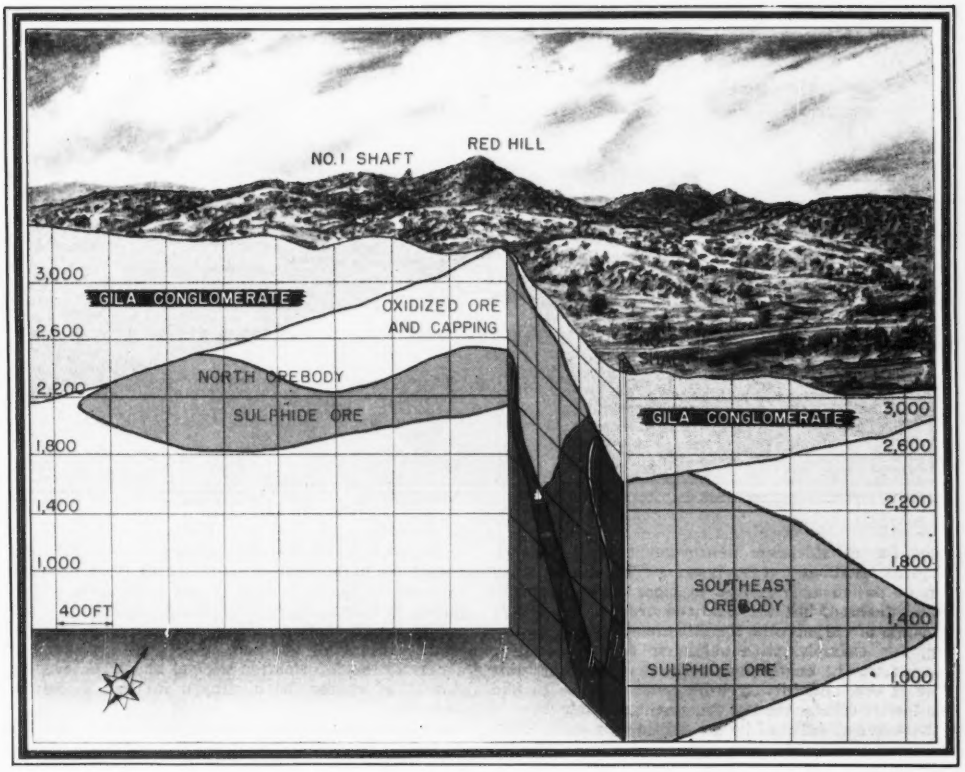
SAN MANUEL COPPER CORP.

WESLEY P. GOSS

General Manager, Magma Copper Co., Superior, Ariz.

SAN MANUEL is one of the very few major orebodies now being developed in the United States that has little or no past history of exploration and development. Covered as it is with a thick layer of barren conglomerate, the San Manuel orebody went undiscovered until late in 1943. Intensive exploration since then, however, has proved it to be the second largest copper orebody known in the United States.

It is true that Red Hill, an iron oxide-stained outcrop of monzonite, did attract early prospectors to the area (see map), but they found nothing interesting. Not until the U. S. G. S. and the U. S. Bureau of



SAN MANUEL'S copper orebody, nation's second-largest, comprises two major divisions. Steeply-dipping, oxide-capped north orebody will not be mined until oxide treatment is worked out. No. 2 shaft should reach southeast's easily-mined sulphide ore by this fall.

Mines began to explore the region in November, 1943, did the outlines of a copper orebody begin to appear.

Shortly thereafter the Magma Copper Co. became interested in the property. Dr. John Gustafson, at that time consultant for Magma, recommended that the company buy the San Manuel claims, and an option to do so was taken in August, 1944. The option was exercised in September, 1945, and the San Manuel Copper Corp. was formed to explore and develop the property.

From 1943 until February, 1948, the San Manuel orebody was explored by means of 105 churn drill holes, adding up to a total footage of 195,936. In the shallower parts of the orebody, a few holes had to be put down beyond 1,500 ft. In the deeper parts, few holes went less than 2,000 ft. and several went beyond 2,700 ft. The deepest hole was 2,850 ft.

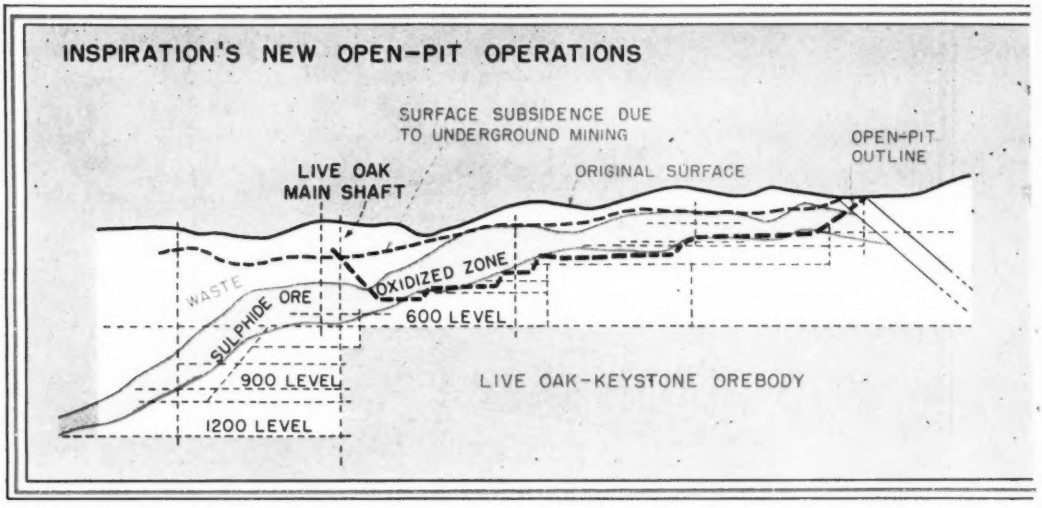
Core drilling, from small diamond tools to 9-in. rotary rigs, was tried but with no success. The orebody is interlaced with small fractures running in all directions. The core always broke on these fractures and was ground to pieces by the bit.

At first the drilling proceeded on the same coordinate system used by the Bureau of Mines. Holes were spaced on centers 400 ft. apart along the supposed strike, and on 200-ft. centers across the short axis of the orebody. As the orebody was outlined, the 400-ft. spacing came to be used in both directions. Of the total footage mentioned previously, the Bureau drilled 17 holes with a total of 15,844 ft. San Manuel deepened several of the Bureau's holes and put down 88 new holes for a total of 180,092 ft.

The full extent of the orebody is not yet known, however, because San Manuel stopped drilling after 460,000,000 tons of copper ore was developed. A series of holes along the southwest perimeter of the drilled area shows good columns of ore. The best of these has a vertical thickness of 1,700 ft. averaging better than 0.7% copper. The bottom 500 ft. in this hole assayed 0.9% copper. We do not know how far the orebody may extend beyond this line of holes.

The drilling outlined two distinct types of ore, sulphide and oxide. Also, the shape of the orebody lends itself into division into two parts for purposes of description and development of mining method. These two are the North orebody and the Southeast. The shape and relationship of these two divisions are shown in the accompanying section.

A large portion of the oxidized ore overlies some of the sulphide ore in the North orebody. This sulphide ore widens in section into the Southeast orebody, which has little or no capping of oxidized ore. At present the company plans to postpone mining the oxidized ore because it is believed that there is still



room for considerable improvement in the metallurgical treatment of such ores. The sulphide ore can be milled and smelted in more or less conventional fashion, but the oxidized ore contains large amounts of chrysocolla, the silicate of copper. Leaching, for example, with sulphuric acid or another reagent, is the only known method of handling this type of ore, and further work must be done to find the lowest-cost method of treatment possible.

Reserves as outlined by the drilling are as follows:

	Tons Ore	Total Cu%	Oxide Cu%
SULPHIDE ORE			
North orebody	178,762,616	0.784	0.036
Southeast orebody	160,522,304	0.795	0.025
TOTAL SULPHIDE	339,284,920	0.789	0.031
OXIDIZED ORE			
Plus 0.7% Cu	73,165,975	0.866	
Plus 0.5% Cu	123,499,580	0.767	

These orebodies are covered with several hundred feet of Gila conglomerate. Most of the developed tonnage, in fact, is so far below the surface that stripping and open-cut mining is out of the question. The structure of the monzonite as we have been able to observe it on the surface, and our experience in drilling, lead us to believe that block caving will prove to be a suitable and economical method of mining. Although the San Manuel orebody is lower in grade than many other large copper orebodies, it is not as low as the lowest grade porphyry copper orebody in the United States now being mined by underground methods. (This distinction, it is believed, is currently held by Miami Copper Co. *Ed. note.*)

Having proved a definite tonnage of ore, it becomes necessary to get into the orebody, both to get representative samples for metallurgical testwork and to study the ore in place, and broken, in order to plan finally the development and extraction methods.

To this end, two shafts are now being sunk. The No. 1 shaft (see section) is 7x26½ ft., outside the sets, has four compartments, and will be sunk 2,140 ft. The No. 2 shaft is 7x20 ft., has three compartments, and will be sunk 1,960 ft. About 14,000 ft. of drifting and crosscutting is planned on two levels.

These shafts will aid in development and extraction when mining begins. The No. 1 shaft is located in the footwall of the orebody and is intended to be one of the permanent hoisting shafts. It will have a capacity of 15,000 tons daily and eventually will be joined by a twin shaft of identical capacity.

The No. 2 shaft is being sunk directly into the Southeast orebody (see section). It will give quickest access to the information needed about the ore, but it will, of course, be destroyed in time as mining proceeds.

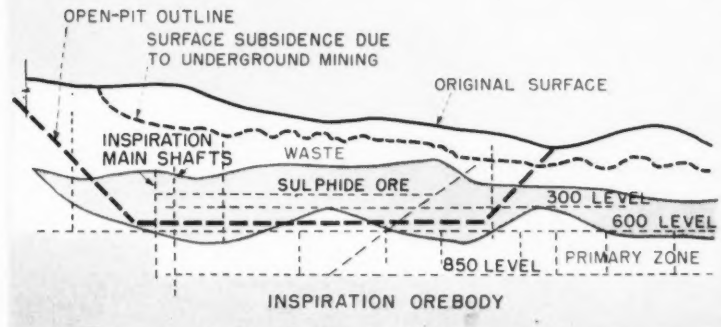
It is not known what quantity of water is likely to be met underground, but it is known that the ground is water-bearing. The water table, as disclosed by the drilling program, lies from 300 to 700 ft. below the surface.

It is also known that a producing mine lying several thousand feet north of the San Manuel property is pumping over 2,000 gpm. from its 1,050-ft. level. It is not known, however, whether or not this may be taken as indicative of the flow of water that may be encountered underground in opening up the San Manuel orebody.

The footwall shaft (No. 1 in the section) was carefully located in an area that seemed least likely to produce much water, but provision has been made for any eventuality.

It is too early, of course, to form definite plans for mining the San Manuel orebody, but we do have certain hopes with regard to it. We expect to be able to develop caving blocks or panels 700 ft. long, 160 ft. wide, and 600 ft. high, where the orebody is thick enough. Few blocks this size have heretofore been caved. At any rate, we plan to draw as widely as possible on previous experience with this method and to keep our own planning flexible at all times.

We have thought of the possibility of using a belt conveyor instead of a hoist to move ore out of the mine. A successful conveyor operation would offer several advantages, but our present belief is that belt life would be too short, and maintenance too much of a problem, to enable a conveyor to compete with hoisting for this service. However, belts are constantly being improved and it will be possible to turn to conveyors as a hoisting method if conditions are found to warrant it. The permanent footwall



Open-pit operations have been started at Inspiration and Live Oak–Keystone orebodies to supplement underground methods. This combination will yield maximum recovery of copper reserves.

shaft could then be used as a ventilation and supply shaft, which will be needed in any case.

San Manuel's engineers are planning the plant layout, townsite, and transportation facilities that are needed for a modern 25,000-ton mining and milling operation. It has not yet been decided whether San Manuel will build its own smelter or have its copper concentrate custom-smelted.

Development, as outlined in the foregoing discussion, is proceeding. The No. 1 shaft, early in June, was down 730 ft. and the No. 2 shaft was down 380 ft. We expect to strike the orebody in the No. 2 shaft at about 750 ft. Upon what we find thereafter will depend the course of much of our subsequent work. We are sure, however, that whatever this course may be, we shall in its progress add significantly both to our store of technical knowledge and to the nation's supply of copper.

INSPIRATION

P. D. I. HONEYMAN

Manager, Inspiration Consolidated Copper Company

DURING THE WAR Inspiration Consolidated Copper Co. operated its property at full capacity and mined the best available grade of ore to produce the maximum poundage of copper for the war effort. When hostilities and the vital defense need for copper ceased, it was time for the Inspiration company to sit back and take stock.

Portions of the Inspiration orebodies, particularly along the southerly fringes of the Live Oak and Inspiration orebodies (see illustration), are too thin or, in some cases, too low grade to be mined economically by the underground block-caving system of mining which had been heretofore Inspiration's sole mining method. However, extensive studies indicated that these portions of the ore reserve could be mined economically by open-pit methods. These studies were converted to action, and the open pit was equipped and put into operation a year ago. No new or additional orebodies are involved, and operations in the future will consist of a combination of open-pit and underground mining.

The Inspiration orebody contains a mixture of sulphide and oxide copper minerals. The plant process for the recovery of the copper consists of leaching by means of sulphuric acid and ferric sulphate. Success of this process depends on careful control of grade and relative proportions of sulphide and oxide minerals. Such control is more readily accomplished by a combination of underground mining with the more flexible open-pit mining.

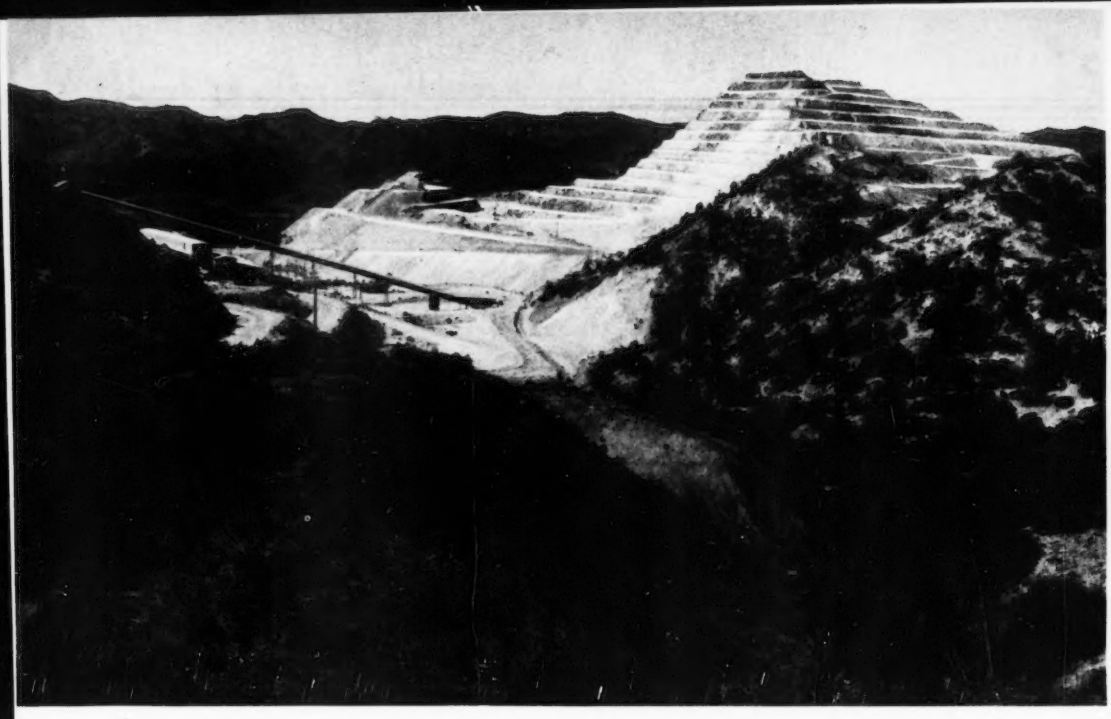
Accompanying illustrations reveal sections through the orebodies. Both main shafts, Live Oak and Inspiration, are shown. From underground operations ore is hoisted through both shafts. The outlines of the two open-pit areas are also shown. Ore from the open pit is handled by electric shovels and is transported by heavy trucks to the open-pit primary crusher. From the pit storage bins the ore is hauled by railroad to the main crushing plant, where it joins the flow of ore coming from underground operations.

By these combined mining methods the company will be able to obtain maximum copper recovery from its remaining ore reserves.

MIAMI AND CASTLE DOME

PRODUCTION from the Miami mine started in 1911. Since 1925, operations have centered around the lower grade portion of the deposit which, prior to that time, had not been considered as ore. Miami is presumed to be the lowest-grade copper deposit that has been operated successfully by underground methods. Tonnage and grade of production in recent years have remained fairly constant.

Exploitation of the Castle Dome orebody, in conjunction with the Reconstruction Finance Corp. through its subsidiary, Defense Plant Corp., was started by Miami Copper Co. during World War II. Castle Dome Copper Co., Inc., a wholly-owned subsidiary of Miami Copper Co., was organized to operate the deposit. The short time (17 months) in which the



CASTLE DOME COPPER CO., a war-born development that has produced at a rate of 50,000,000 lb. of copper per year.

plant was erected and the mine prepared for production reflects the urgency of the demand for metal at that time. Production at a rate of about 50,000,000 lb. of copper per year has been maintained since the start of operations.

Current exploration efforts at Miami, through churn drilling, have disclosed a deposit near Miami which is strikingly similar to the Castle Dome orebody. Whether this deposit constitutes a commercial orebody depends upon many factors, some of which present problems for which a solution has yet to be found.

MAGMA COPPER CO.

MAGMA COPPER CO.'S new 1,500-ton mill, described in the December, 1948, issue of *Engineering and Mining Journal*, started up in January, 1949, and has operated continuously since then. Performance has exceeded expectations, as the two new units, designed to handle 500 tons each per day, have actually been handling 600 tons each with ease and with excellent results. Two smaller units are being moved over from the old mill and they should be ready for operation by July, 1949.

The new refrigeration plant for cooling underground workings in the Magma mine has been in operation since August, 1948. It performed satisfactorily through the winter. This additional refrigeration has given access to areas of the mine that formerly could not be mined because of high rock temperatures.

RAY MINES DIVISION

KENNECOTT COPPER CORPORATION'S Ray Mines Division plans to install additional capacity in both the mine at Ray and the mill at Hayden to make possible an increase in output from the present rate of 6,000 tons per day to a possible 15,000 tons daily.

To do this, the remaining unmined portion of the No. 1 orebody will be taken out by open-pit methods. The No. 2 orebody will continue to be mined by block-caving, but production from it will be curtailed somewhat as the open-pit production expands.

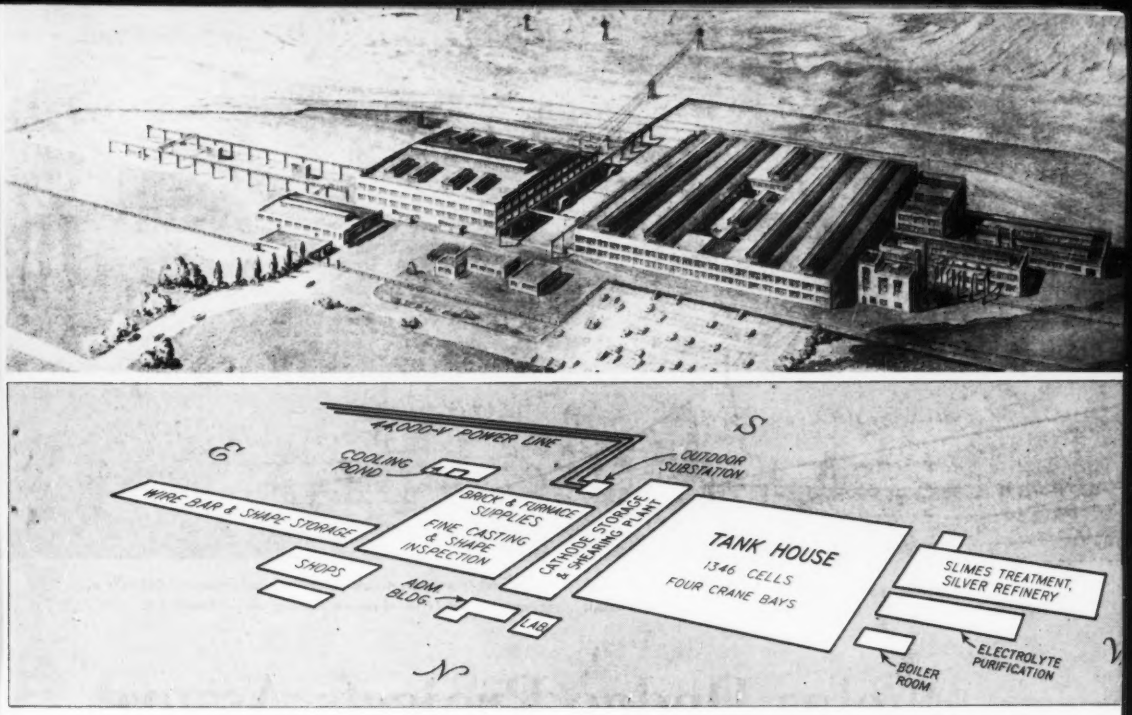
As is the case with Inspiration, cost is a large factor in the conversion from underground to open-pit mining methods. Unit costs for underground mining are higher than the estimated cost of mining the same ore by open-pit procedures at both Ray and Inspiration.

At Ray, a thickness of about 400 ft. of ore will be mined. Haulage roads for trucks inside the pit will be held to a maximum grade of 6%. Outside the pit, maximum grade will be 4%.

Ore from the pit operation will be crushed in a 60x84-in. jaw crusher, newly-installed for the purpose. The 8-in. discharge from this crusher will travel by conveyor to the present crushing plant at the mine, where it will join the underground ore to be reduced to $\frac{3}{4}$ in. for the rail haul to the mill bins at Hayden.

The Hayden concentrator is being expanded to take care of the increased output of the mine. The four 9x12-ft. rod mills already installed are believed adequate for the present in reducing the $\frac{3}{4}$-in. ore to about 8 mesh. Additional ball mill capacity will be needed, however, and four $10\frac{1}{2}$x14-ft. ball mills are being installed. Additional flotation capacity is also being provided.

The Hayden smelter, operated by American Smelting & Refining Co., is also expanding its facilities to take care of the increased output from Ray. A new turbo-generator, a new turbo-blower for the converters, and another converter will be added to the plant.



NEW REFINERY is designed to produce 12 to 16 thousand tons of copper per month and provides for the recovery of precious metals and byproducts. Plant units will include an electrolyte purification section and a physical testing and chemical laboratory.

Kennecott Builds Modern Refinery

IN 1950, the new $16-million electrolytic refinery now being erected by Kennecott Copper Co., near Garfield, Utah, will begin treating blister copper produced by the company's Utah properties.

At present, blister copper is being refined at eastern plants, but with the substantial shift in copper demand to the mid-west and recent increases in freight rates, this practice is no longer advantageous. This, along with a low power cost available by using electrical energy generated at a central power plant near the Magma mill, and operational savings to be expected from a new plant, were the major factors in Kennecott's decision to erect a new refinery.

The refinery is designed to produce 12,000 tons of copper per month. However, by increasing the number of anodes in the tank house from 36 to 41 per cell and raising the current density from 15 to 18 amps. per sq. ft. of cathode surface, the rate can easily be increased to 16,000 tons per month.

Electrolytic cells will be made of pre-cast concrete and lined with 8-lb. lead containing 3% antimony. They will be 13 ft. 7 in. long, 43 in. wide and 49 in. deep. There will be 1,346 commercial cells in the main tank house and 36 decopperizing cells in the electrolytic circuits.

Three of the five separate electrolytic circuits will produce commercial cathodes. One will make starting sheets and the fifth will be for the purification of the electrolyte.

Three 15-ft. ID electric arc furnaces in the casting house will have automatic control equipment and will be equipped with 100-kw., 460-v. single phase induction holding furnaces. Two of the furnaces will be used for melting cathodes and refined copper rejects. These will have 40-ft. dia. Walker casting wheels and will handle 40 tons per hour. If necessary this tonnage can be cast on one wheel by running molten copper from both furnaces to the same holding furnace and thence to the ladle, casting wheel and bosh. Products will be ingots, ingot bars and wire bars.

Casting equipment for the third furnace, remelting anode scrap, will be similar except that the wheel will be 24 ft. in diameter. Anodes will be lifted directly from the moulds to industrial cars as there will be no bosh. Cooling and descaling will be done by passing the loaded cars through water sprays.

Power will be transmitted at 44,000 v. from the Utah Copper steam turbine plant near the Magma mill, 2½ miles away. Transformers at the refinery will reduce the voltage to 13,800 for plant distribution. Direct current for the electrolytic circuits and electrolyte building will be supplied by six 2,000-kw. synchronous motor-generator sets (includes one stand-by set). Each set is to have two 125-v., 8,000-amp. d.c. generators, driven by a common 2,900-hp., 13,200-v. motor. Three 300-kw. mercury arc rectifiers will supply 250-v. power for all plant cranes.

Provision has been made to install a water purifying plant and two 40,000-lb. low pressure boilers to supply process steam.

MORENCI. Here mining crews handle 50,000 tons of ore and 65,000 tons of waste per day. During 1948, this pit produced about 15,600,000 tons of ore which yielded approximately 148,000 tons of copper, or about 19 lb. of recoverable copper per ton of ore.

Phelps Dodge Projects Assure

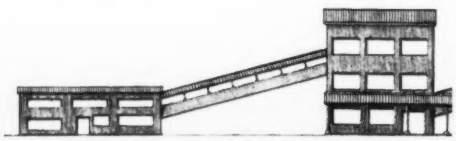
A major expansion program to increase capacity and improve plants started in 1937 is still under way. Total cost will be about $80,000,000. This does not include purchase of additions financed by the Defense Plant Corporation.

PRODUCTION OF COPPER from mines of the Phelps Dodge Corporation increased from 129,022 tons in 1938 to 246,725 tons in 1948. Most of the copper came from the Morenci and Ajo open pits in Arizona where ore mined in 1948 yielded 19 and 14 lb. of recoverable copper per ton, respectively. With grades of ore like these, Ajo and Morenci pits would remain mountains of waste were it not for the large-scale economical methods devised to mine and treat the ore, and for the courage of investors to back up the projects. An account of what Phelps Dodge has recently done and continues to do to assure a future supply of copper follows.

Morenci. The company started a major expansion program in 1937, especially in connection with the development of the open-pit mine at Morenci. The original plan called for the production and treatment of 25,000 tons of ore per day. During the war the Defense Plant Corporation financed new mine developments and construction of new plant additions to increase capacity up to more than 45,000 tons per day. These additions included new housing at Morenci and a large addition to the electrolytic refinery of the Phelps Dodge Refining Corporation at El Paso, Texas. During the past year the company has purchased all these facilities from DPC for $19 million. By other improvements production has been increased to about 50,000 tons per day. In addition to housing and community improvements, a 40-mile electric transmission line has just been completed to provide power for a pumping plant north of Morenci.

Ajo. At the New Cornelia Branch, Ajo, the open-pit mine has been expanded during the past few years, and production increased from about 22,000 tons to 28,000 tons per day. Steam locomotives for pit haulage have been replaced by both electric trolley locomotives and diesel-electric locomotives, the latter being used ordinarily on the upper benches. The trolley locomotives are equipped with auxiliary diesel motors to permit operation on benches and other parts of the mine where trolleys have not been installed. The power plant is being enlarged to provide for two new high-pressure boilers and a 10,000-kw. high-pressure parallel-flow turbine. A new 54-in. crusher is being installed to replace a smaller unit in the crushing plant, and a 200-ft. thickener is being added.

NEW SMELTER NOW GOING UP AT AJO will have a capacity of about 10,000,000 lb. of copper per month. The plant should be completed by the summer of 1950.



AJO. Ore production here has been increased from about 22,000 tons per day to 28,000 tons per day. Waste handled daily averages about 21,000 tons. In 1948 this mine produced 55,000 tons of copper from ore averaging about 14.0 lb. recoverable copper per ton.

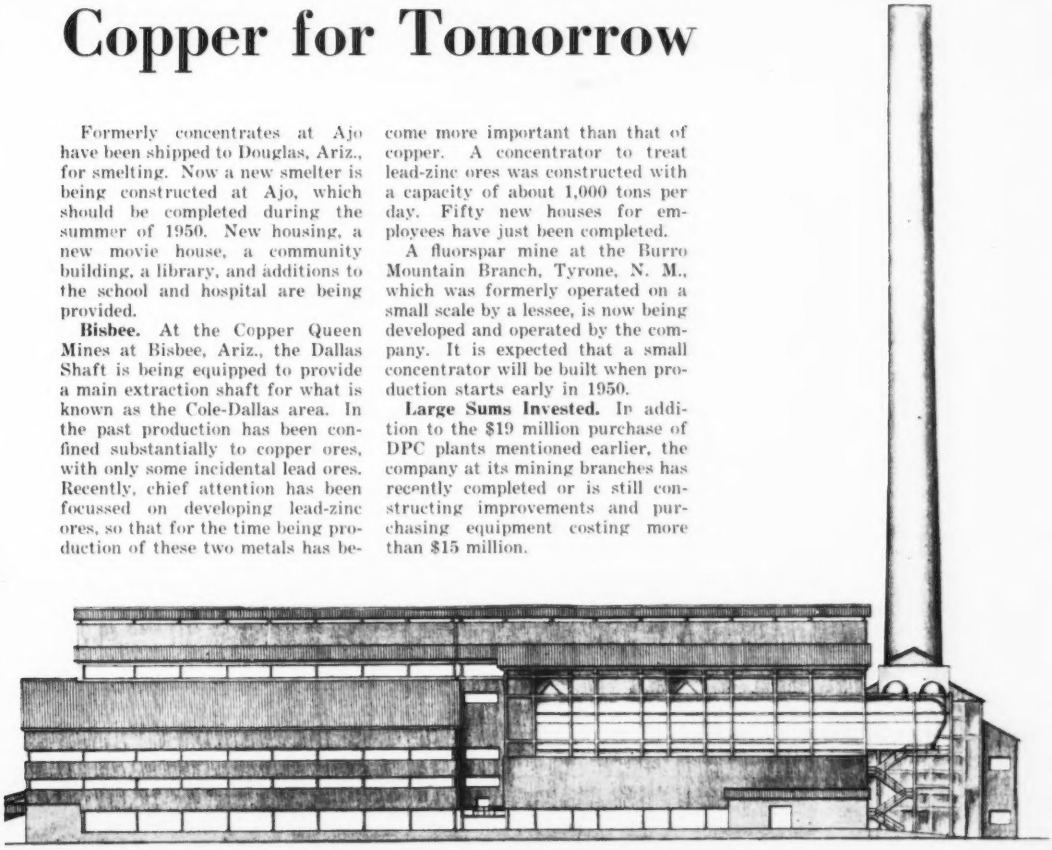
Copper for Tomorrow

Formerly concentrates at Ajo have been shipped to Douglas, Ariz., for smelting. Now a new smelter is being constructed at Ajo, which should be completed during the summer of 1950. New housing, a new movie house, a community building, a library, and additions to the school and hospital are being provided.

Bisbee. At the Copper Queen Mines at Bisbee, Ariz., the Dallas Shaft is being equipped to provide a main extraction shaft for what is known as the Cole-Dallas area. In the past production has been confined substantially to copper ores, with only some incidental lead ores. Recently, chief attention has been focussed on developing lead-zinc ores, so that for the time being production of these two metals has become more important than that of copper. A concentrator to treat lead-zinc ores was constructed with a capacity of about 1,000 tons per day. Fifty new houses for employees have just been completed.

A fluorspar mine at the Burro Mountain Branch, Tyrone, N. M., which was formerly operated on a small scale by a lessee, is now being developed and operated by the company. It is expected that a small concentrator will be built when production starts early in 1950.

Large Sums Invested. In addition to the $19 million purchase of DPC plants mentioned earlier, the company at its mining branches has recently completed or is still constructing improvements and purchasing equipment costing more than $15 million.



BLOCK CAVING will add decades to productive life of Butte's "Richest Hill on Earth." Orebody projections are outlined.

Building A Greater Butte

PROBABLY THE CHIEF significance of the Greater Butte Project is the addition, by private enterprise, of at least 2,600,000,000 lb. of copper reserves to the resources available to industry within the United States. It is the perfect example of the extension of this nation's ore reserves by means of technologic improvements.

To Butte, itself, however, the salient fact is that the addition of the Project's ore to the regular copper, zinc and manganese ore production of the Butte Hill's many veins means that the productive life of the district is lengthened by decades.

The Greater Butte Project is a development that will supplement, not replace, present mining in the Butte district. It is the result of a carefully planned program of research and study by the various departments of Anaconda Copper Mining Co.

Briefly, the Project is to mine certain previously-known copper-bearing zones by low-cost block caving. Eleven ore zones estimated to contain from 2 million tons in the smallest to 60 million tons in the largest are included in the area to be mined. Total tonnage is estimated at 130 million tons with an average content of 20 lb. of recoverable copper per ton of ore.

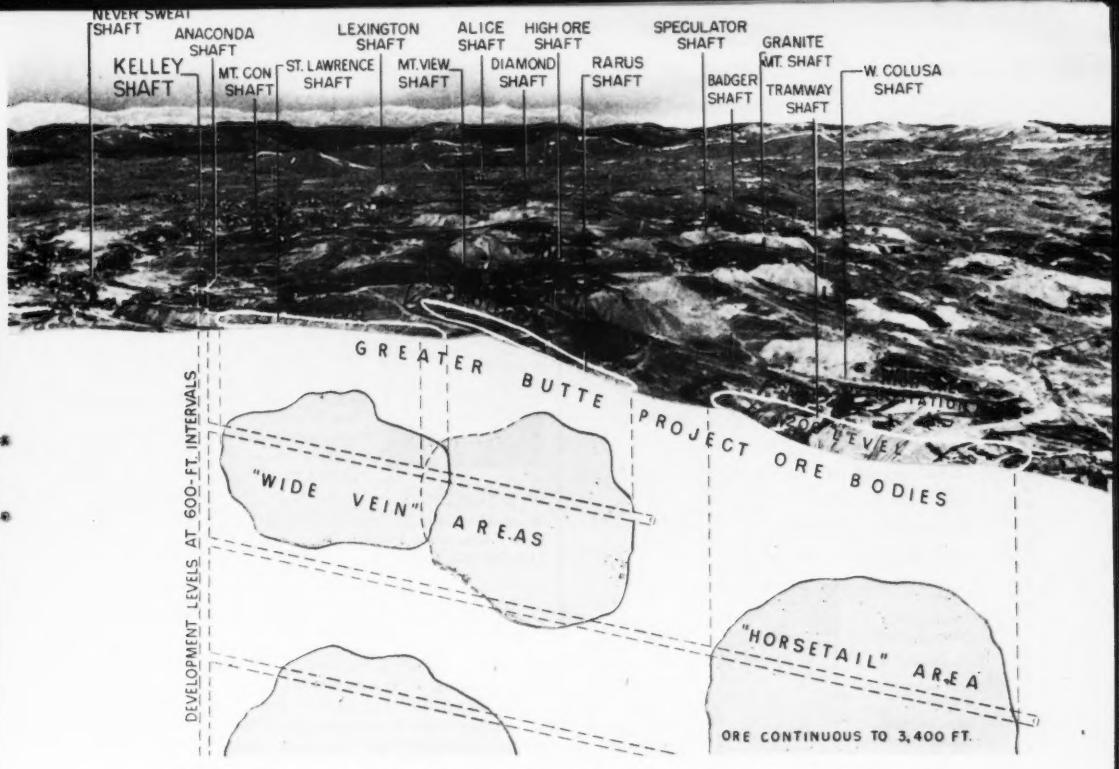
Geologically, these orebodies are located in the most intensely altered, multi-fractured granite area in Butte, which makes them well-suited for block caving methods. Heretofore, application of this method has been held up because some of the stoped-out sections in this area were known to be potential fire hazards if supplied with oxygen. Other areas were known to contain fire gas. Both presented serious problems for future "re-mining" of the sort now under way.

Recently, however, tests with introduction of concentrator tailings pulped in water and under pressure have proved conclusively that if all such openings are filled with this material, the danger is removed. The fire and gas hazards are eliminated and the sections are put in good condition for later mining by block caving.

The several zones were "re-developed" by driving about 21,000 ft. of cross-cuts through them at proper intervals of seven horizons. All of the ore exposed in each cross-cut was sampled, not only by usual hand-sampling and car sampling, but also by shipping the bulk material excavated to the Washoe Sampler, Anaconda's custom ore sampling mill.

To determine the feasibility of mining the different zones by the caving system, two test blocks were actually mined. Results demonstrated that the orebodies could be mined by this system, and that by careful control, estimated tonnages and grades of ore could be maintained.

Concentration tests by the metallurgical research department began on a laboratory scale, then went to pilot plant scale, and finally to a full-scale operation



ACCESS to new ore is through Kelley shaft and haulage levels shown. Orebodies take names from vein characteristics.

basis at 500 tons a day on 70,000 dry tons of the sample rejects from the Washoe sampler. This work resulted in development of a process whereby, from a low-grade mixture of copper sulphides and sulphates, a satisfactory recovery of the contained copper in the Greater Butte Project ore can be made.

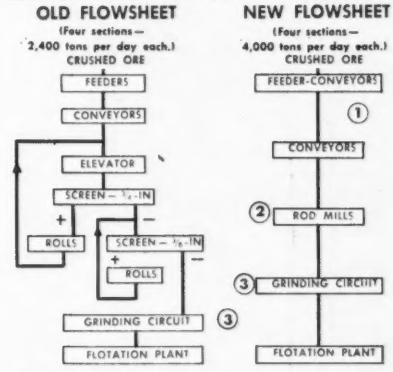
Certain changes are being made in the Anaconda mill flowsheet in order to increase both efficiency and capacity in handling Project ore. These changes, largely confined thus far to the grinding circuit, are summarized in the accompanying flowsheet.

Successful completion of development, and mining and concentration tests, made it possible for Mr. C. F. Kelley, chairman of the board of Anaconda Copper Mining Co., on Sept. 10, 1947, to announce and name the project. He stated then that $20 million would be spent over the next three years in preparing to mine these orebodies.

Present estimates are that enough work will have been done by the latter half of 1951 to permit mining 5,000 tons of ore per day. In the first six months of 1952 this rate may be raised to 10,000 tons daily. During the last half of 1952, it is hoped to reach the full capacity of 15,000 tons daily.

The Kelley Shaft, through which the orebodies will be reached, is being sunk in Dublin Gulch on the Butte Hill, as shown in the above photographs. The shaft, 9x38 ft. in cross section, will have four compartments and will be lined with pre-cast concrete slabs. A 3,000-hp. Allis-Chalmers hoist will handle the 12-ton bottom-dump skips. Ore trains on haulage levels will consist of twenty 5-ton cars pulled by 10-ton trolley locomotives.

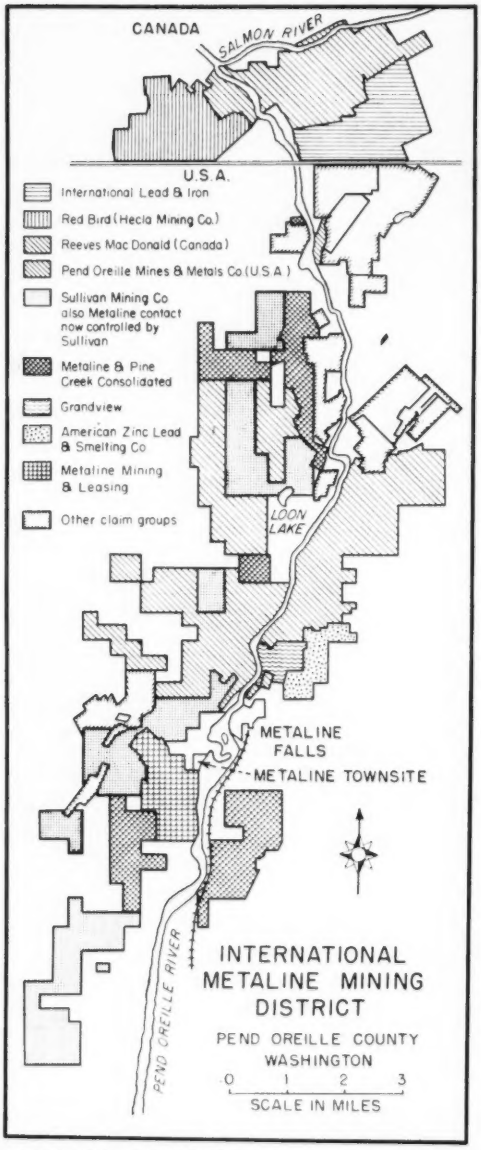
MILLING GREATER BUTTE PROJECT ORE



LEGEND

1. For some of Project ore scrubbing mills and desliming classifiers may go here. Sand fraction, mostly sulphide can be floated. Slime fraction containing most of oxides will be treated separately.
2. Two 9x12-ft. Marcy rod mills feed 20% plus 1-in. discharge 6% plus 14 mesh.
3. Five Hardinge mills in closed circuit with 72-in. Akins classifiers. Four operate, one is held as spare.

A cross-continent review of lead-zinc mining programs leaves no basis for concern about this industry's ability to find new reserves and to devise ingenious and economical methods to mine them



MAJOR MINING COMPANIES have shown interest in the Metaline district extending some 20 miles in the northeast corner of the state of Washington. Sketch above shows property holdings based on district map by Goodsell & Karlsten, mining engineers, Spokane, Washington.

"Development of the international Metaline lead-zinc mining district is now progressing at a rate it deserves, proven by results of an extensive drilling program over the last 15 years. Present indications are that expanding production from new plants now under construction will replace, in part, production of other districts in the United States which have been depleted."

W. L. ZEIGLER
General Manager
Pend Oreille Mines & Metals Co.
Metaline Falls, Washington

The Metaline Mining District

A FUTURE "Tri-State" lead-zinc producing area is rapidly evolving in the northeast corner of the state of Washington and across the border where extensive development work and plant expansion are under way. Active producers in the area include Pend Oreille Mines & Metals Co., American Zinc Lead and Smelting Co., and Metaline Mining & Leasing Co. Prospecting in the area dates back to the turn of the century, and mining has made some gradual strides since then. But the real impetus to growth was touched off by comparatively recent diamond drilling conducted by private companies and with U. S. Bureau of Mines assistance during the war.

Lead-zinc orebodies in this area are of the replacement type. There are three major ore zones, the Josephine, Yellowhead and Reeves. All work is done in the Josephine. The beds are faulted and folded and have low dips in various directions. They underlie large areas of the district. (See map of property holdings.) Orebodies vary in thickness from 10 to 100 ft., and mining is currently carried on over widths up to 1,200 ft. Present grades run 5 to 7% zinc, and 0.5 to 4% lead.

Following encouraging results in diamond drilling, Pend Oreille Mines decided to expand mining operations and open up a new mining section on the east bank of the Pend Oreille River in 1946. The program involved sinking an inclined shaft (see following pages) and construction of a 2,400-ton concentrator. Early in 1948, the Sullivan Mining Co., a subsidiary of the Bunker Hill & Sullivan Mining and Concentrating Co. and Hecla Mining Co., started participation in this development, and under the arrangement an additional $3.5 million was made available for construction work in progress. Pend Oreille Mines has also equipped and placed into operation the Reeves MacDonald lead-zinc mine near Nelway, B. C. Mined ore is treated in the new 1,000-1,200-ton concentrating plant.

Very recently it has been announced that the Sullivan Mining Co. has acquired controlling interest in the Metaline Contact Mines, also in this district. The Grandview and Metaline mines are currently inactive.

NEW REEVES MACDONALD MILL will house two separate 500- to 600-ton units.

Reeves MacDonald—A Major Producer

EARLY IN MAY, Pend Oreille Mines & Metals Co. placed into operation its Reeves MacDonald lead-zinc property in southern British Columbia. The mine is now the Province's second largest lead-zinc producer. Pend Oreille Mines acquired control of the property in 1928. Holdings consist of 64 Crown-granted claims and fractions, totaling 2,278 acres.

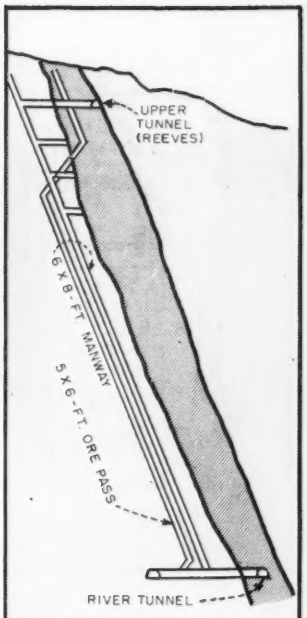
Development consists of an upper tunnel about 1,000 ft. long, known as the Reeves, with crosscuts to explore the orebody at this horizon, lower tunnel, known as the River tunnel, 5,224 ft. long and some 800 ft. below the Reeves tunnel, and two raises driven for a distance of about 1,000 ft. between the River tunnel and Reeves tunnel on a slope of 54 deg.

Mineralization consists of fine-grained argentiferous galena and sphalerite in crystalline limestone. Fine crystals of pyrite are also present. Average grade of the ore is about 0.8 oz. silver, 1½% lead, 6½% zinc, and 7% iron. Concentration tests indicate that a zinc concentrate containing 60% zinc can be produced. Development has disclosed some 3 million tons of ore. This does not include any tonnage below the River tunnel or other orebodies known to exist in the property but not developed.

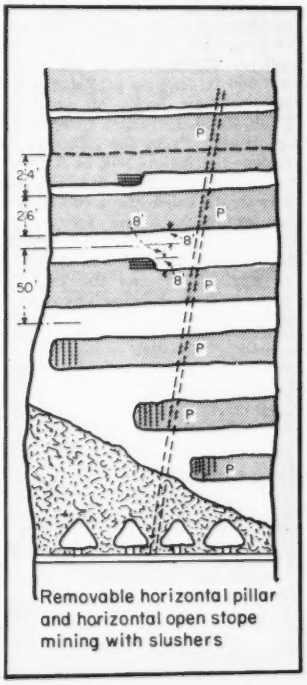
Owing to the character of the Reeves limestone and widths of ore up to 80 ft., ore will be mined by a removable horizontal pillar and horizontal open stope method with slushers. As planned, sublevels will be driven at 50-ft. intervals from the raise, subsequently to be slashed to full width and the full length of the orebody. This will be done in 8-ft. benches, the blast holes to be drilled with wagon drills. The resultant 26-ft. pillars will be blasted by drilling vertical blast holes.

The crushing plant contains a 30x30-in. New Holland breaker served by a 42-in. apron pan feeder and operating in closed circuit with a 5x12-ft. vibrating screen. Undersize from the screens will be conveyed to two circular concrete fine-ore bins. In the mill building are two separate milling units, each capable of handling 500-600 tons of ore a day. Grinding and flotation equipment consists of 10½-ft. ball mills with classifiers; conditioner tanks; banks of lead and zinc rougher and cleaner cells, and three and six-leaf filters, each in closed circuit with a 24-ft. thickener.

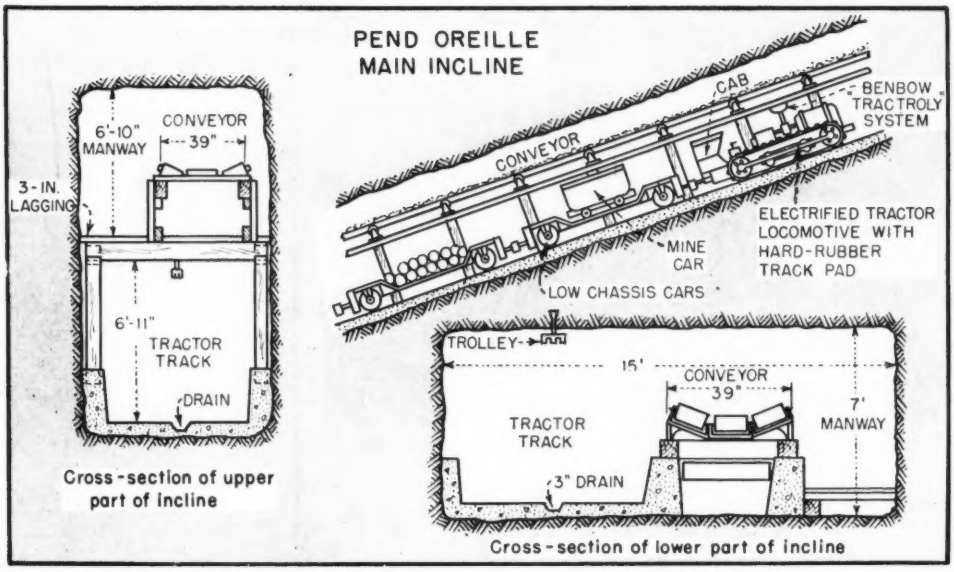
Other surface installations include a two-story, 40x80-ft. combination office building and dry house; 40x60x10-ft. concrete water reservoir; powder house; bunkhouse; cookhouse; and a filter system to provide pure water from the Pend Oreille River. Above the mill building a site is being cleared for a model town development. Electric power for the mine is being supplied by the West Kootenay Power and Light Co. Power received from the 66,000-v. power line extended recently from Salmo, 10 miles distant, is stepped down to plant voltage in a transformer station installed near the mill building.



Cross-section of Reeves Mac Donald Mines



Removable horizontal pillar and horizontal open stope mining with slushers



Pend Oreille Incline to Have Tractor Trolley and Belt Conveyor

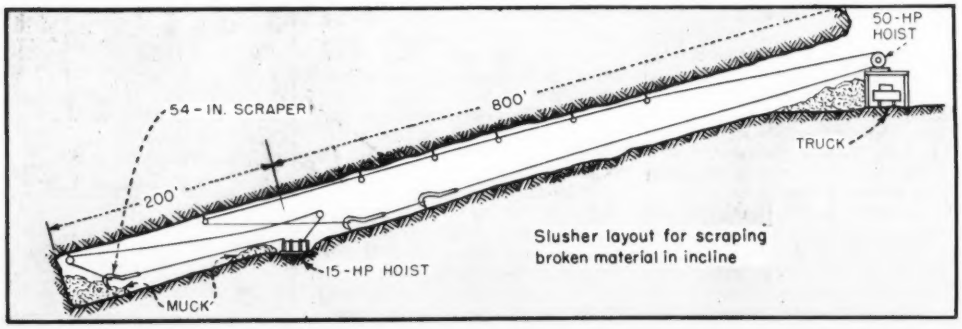
ORE FROM THE NEWLY-OPENED mineralized area on the east bank of the Pend Oreille River, of Pend Oreille Mines & Metals Co., will be carried out of an incline equipped with a belt conveyor and tractor trolley. The first leg of the incline is 1,600 ft. long on a 17-deg. slope, serving four levels at elevations 2,180, 2,000, 1,875 and 1,700 ft., respectively. From the 1,700-ft. elevation, the incline will be flattened to 12 deg. for 400 ft. to give necessary depth below the 1,700-ft. level for ore pockets and for further sinking. The first section running to the 1,875-ft. level was completed in April, 1948, and the 7x7½-ft. opening is now being enlarged to accommodate the conveyor belt and electric tractor trolley installation. For the first 1,400 ft. the incline cross section will be 15 ft. high and 7½ ft. wide. For the next 1,200 ft. and all future extensions the incline will be 15 ft. wide and 7 ft. high.

Scrapers Muck Incline

Scrapers were used entirely to remove muck from the face of the incline to the surface during sinking. As sketched below, a 15-hp. motor scraped ore back from the face. Then it was picked up by two scrapers in tandem placed 15 to 300 ft. apart for 867 ft. of sinking. They moved a load of about 1½ tons. As the drum of the 50-hp. hoist could accommodate only 600 ft. of ¾-in. cable, slushing was done in two steps. A section of portable cable 200 ft. long was inserted in the pull-line, increasing the distance between the hoist and scraper to 800 ft. Broken material was scraped part way, then the 200-ft. section of portable cable was removed, and the muck was scraped up to the surface.

New Conveyor for Shaft

The first section of the 30-in. conveyor will be 1,400 ft. long with a 400-ft. lift, and the second section will be 1,200 ft. long with a 200-ft. lift. A crusher to reduce the mine-run ore and waste to minus 2 in.



will be installed on each main ore-loading level. Each loading point will be equipped with a loader which will control the feed to the conveyor at the required rate of 300 to 350 tons per hour. The loading points will also have magnets to remove tramp iron and steel, and push-button controls to start and stop the belts any time this is desired.

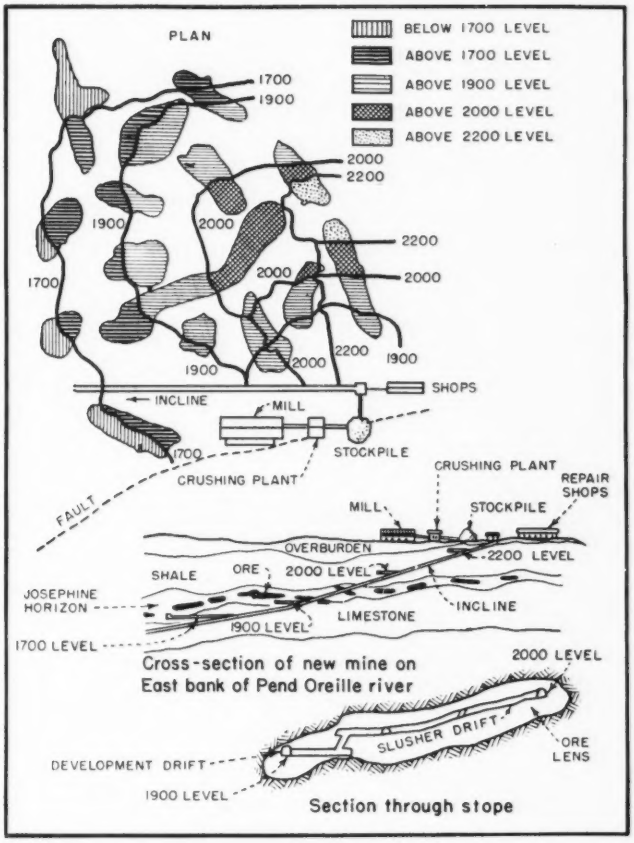
Electric Tractor

The electric tractor trolley locomotive is built from a standard farm-type "Oliver Cletrac" tractor, with caterpillar tracks. To support the electric motor replacing the original four-cylinder gasoline engine, a new undercarriage was constructed and attached to the tractor frame. On the undercarriage is a 30-hp., 440-v., 60-cycle, three-phase, four-speed motor. The motor has operating speeds of 1,800 r.p.m., 1,200 r.p.m., 900 r.p.m., and 600 r.p.m., resulting in tractor speeds of about 5.25 m.p.h., 3.9 m.p.h., 2.6 m.p.h., and 1.3 m.p.h. Control is through a four-speed reversing drum controller. A speed change can be made after the locomotive is in operation.

The tractor trolley locomotive will be served by a Benbow "Tractroly" system. Power feeders to serve the overhead transmission line will be inserted at required points to maintain high operating voltage, with resulting low voltage drop. As a consequence, the overhead trolley system can be extended as the incline is advanced without encountering high line losses or excessive voltage drop.

Transportation equipment will consist of carry-all carts with four rubber-tired wheels and underslung axles. The carts will be equipped to handle men, timber, steel, and mine cars. Air-type brakes will stop the cart should it become detached from the locomotive. Loads will not be rehandled. A mine car will be loaded on the surface with load for delivery to a given level. The operator will ride the locomotive after completion of loading operations, thereby reducing the signal system required and the danger of giving wrong signals. The locomotive tractor tracks are fitted with special hard-rubber track pads.

The incline can follow the Josephine horizon to its northern limit, 20,000 ft. from the portal, and 2,500 ft. below the portal, and makes possible the contour system of mining described and illustrated at right.

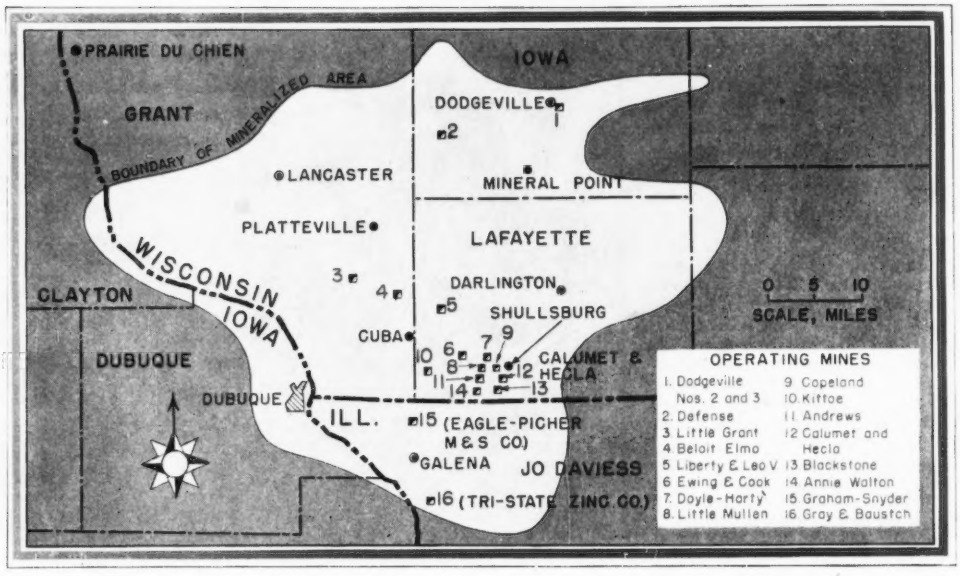


Contour Mining at Pend Oreille

AN INGENIOUS METHOD was devised to extract ore from the irregular deposits shown in the above section and plan of the new mine on the east bank of the Pend Oreille River by the Pend Oreille Mines & Metals Co. Here and at the Josephine mine the company uses a unique contour mining system.

In searching for ore, a 6x7-ft. development drift follows a meandering offset vein of isolated lenses of ore lying nearly horizontal (10 deg.). The lenses vary in length and range from 10 to 100 ft. in thickness. The drift is started in a favorable horizon at a given elevation and follows the mineralized zone, avoiding both foot and hanging walls. Drifting continues through the mineralized ore zone along its approximate strike until a blank face is encountered. Work then stops and short horizontal diamond drill holes are fanned out until another mineralized zone is encountered. Drifting is resumed to intersect the new zone and continues along its approximate strike. Orebodies are mined by open-stope-and-pillar methods, with the drifts serving as haulage levels. A slusher drift in the orebody is used to transfer ore from benches to the haulage level as sketched above. Advantages offered by this method are as follows:

(1) Elimination of surface deep-hole diamond drilling for exploration; (2) less drifting in waste; (3) less raising in waste; (4) much development ore can be taken as mill feed; (5) reduction in underground drilling; and (6) the development of more tons of ore per foot of development drift.



SYSTEMATIC DRILLING on well-planned basis has located new orebodies in this long-lived Upper Mississippi Valley lead-zinc district. New plants are being built by Calumet & Hecla at Shullsburg, and by Tri-State Zinc and Eagle-Picher near Galena.

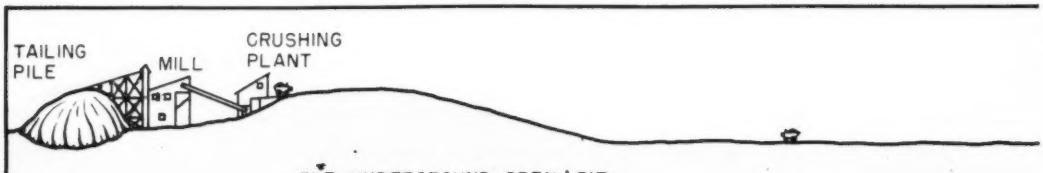
Where New Ideas Made Mines

The Galena-Platteville area on the Upper Mississippi now stands as living proof that mining districts, like old soldiers, never die. Thorough Government exploration, plus private development in the hands of young, or youthfully-minded, men have put three companies to work on new orebodies. The spirit in the old diggings is as new as the ideas one finds being tried there. (See below.)

ERWIN J. LYONS, ALLEN V. HEYL, JR., and ALLEN F. AGNEW

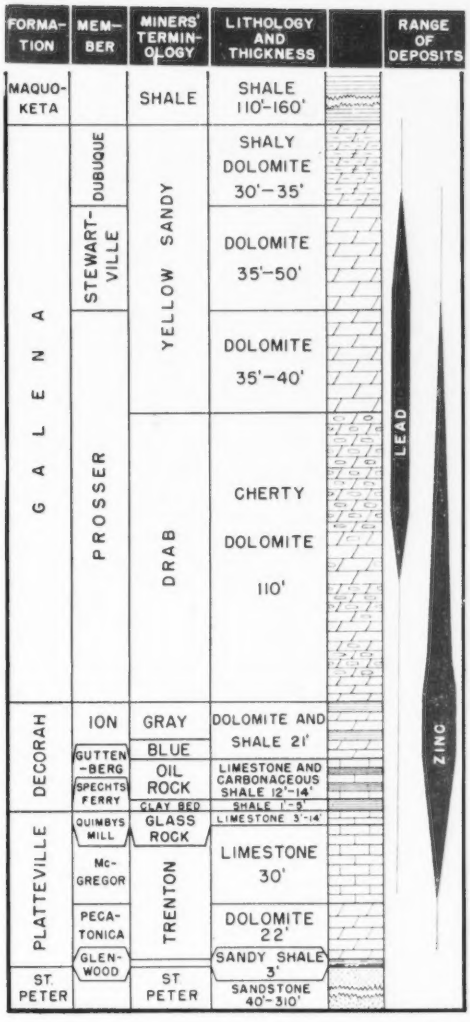
Published by permission of the Director, U. S. Geological Survey. Photographs and sketch from *Engineering & Mining Journal*'s staff.

SINCE 1942 MINING ACTIVITY in the Upper Mississippi Valley zinc-lead district has revived markedly. This renewed activity was largely the result of detailed geologic studies that determined useful criteria for the discovery of new orebodies. These studies were combined with an exploratory prospecting program conducted jointly by the U. S. Geological Survey and the U. S. Bureau of Mines, and in Illinois, with the cooperation of the Illinois State Geological Survey. In 1943 and 1944, for example, this cooperative program resulted in the discovery of over 2 million tons

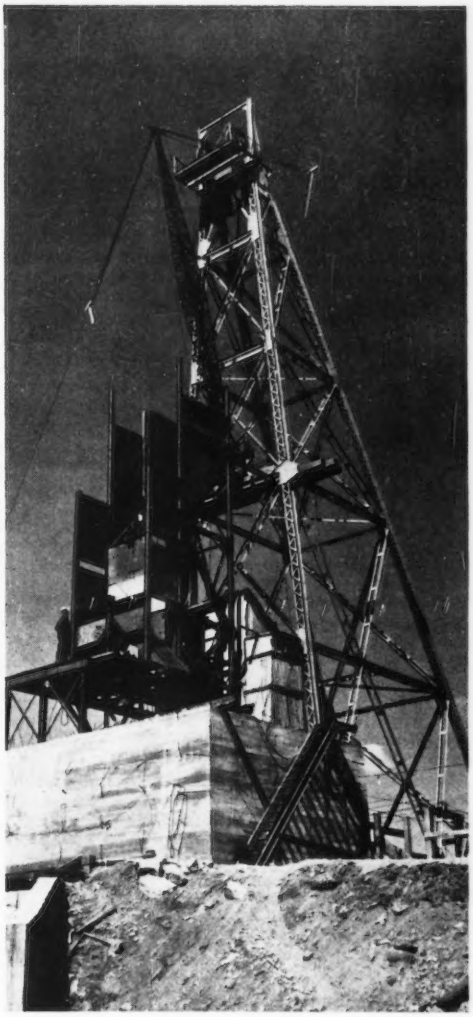


THE UNDERGROUND OPEN-PIT

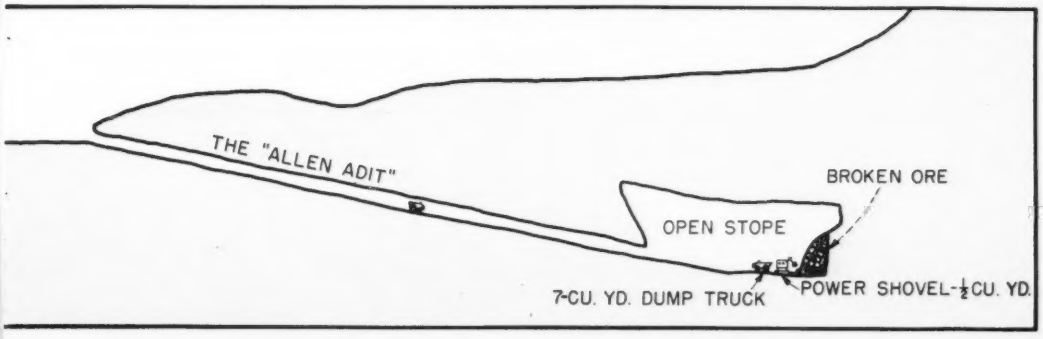
The "Allen Adit" through which Tri-State Zinc, Galena, Ill., will haul ore. Adit is 17 x 12 ft. on 10-deg. incline, 1,700 ft. long. Power shovel will load 7-yd. diesel trucks at face for trip to mill. M. H. Loveman is manager at Galena; Victor C. Allen, general superintendent.

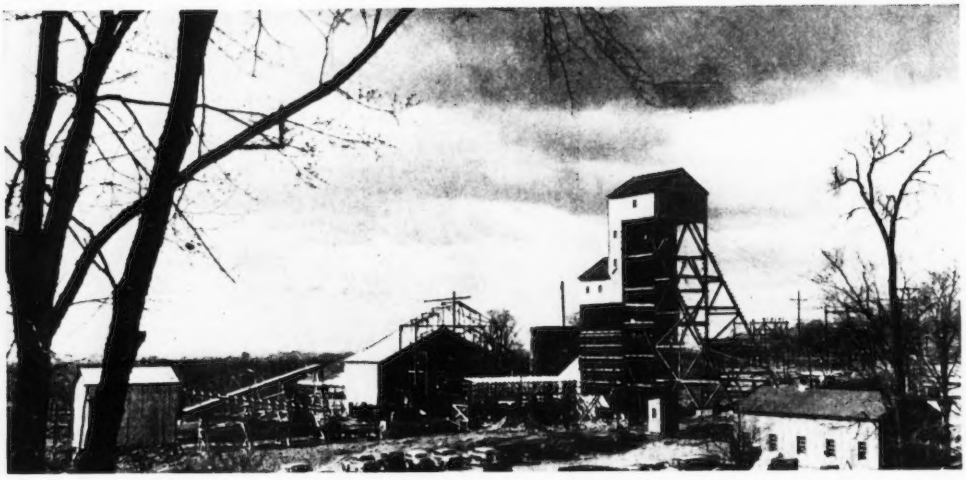


NEW ORE in lower horizons, below "glass rock" once regarded as lower limit of ore, may lead to new theories of orebodies' origin.



NEW HEADFRAME goes in at Eagle-Picher's mine north of Galena, where 1,500-ton mill now operates. E. R. Malocsay is manager here.





POWER SHOVELS and 7-yd. diesel trucks underground will mine ore at Calumet & Hecla's mine near Shullsburg. Harold Ewoldt is manager for C. & H. Mechanized mining methods at area's new mines may raise output to 20 or 30 tons per man-shift.

of ore on the Gray and Bautsch properties in Illinois.

This and other discoveries by the U. S. Bureau of Mines and U. S. Geological Survey caused renewed interest in the district; several companies initiated large-scale drilling programs that have been successful in finding seven important new orebodies. In addition to the Gray and Bautsch properties now being mined by Tri-State Zinc, Inc., other recent large discoveries are: the Graham-Snyder orebody of Eagle-Picher Mining and Smelting Co.; the Blackstone orebodies of Vinegar Hill Zinc Co.; and the Kitto, Hayden and Genzler orebodies of Calumet and Hecla Consolidated Copper Co.

The Upper Mississippi Valley district, which is one of the oldest in the country, was at one time the nation's chief lead producer. The peak of lead production was in the late 1840's after which output declined, and today lead is recovered chiefly as a by-product.

Zinc production began in the 1860's and reached a maximum during World War I. After that period it declined until in the early 1930's zinc mining had practically ceased. In the middle 1930's, construction of a custom-flotation mill revived mining, and under the demand of World War II production increased greatly, until in 1945 the district was the seventh largest producing district in the United States.

The sedimentary rocks of the district are largely of Ordovician age. Rocks of Upper Cambrian age occur in the Wisconsin River valley along the northern border of the district, and Silurian rocks are found in Illinois and Iowa and capping the "mounds" in Wisconsin.

The lead deposits, which are in vertical "crevices," occur in the middle and upper parts of the Galena formation. The main zinc sulphide orebodies are in the lower part of the Galena dolomite and in the Decorah formation. However, increasingly large amounts of ore are being found in the Platteville formation—the "Glassrock" and "Trenton" of the miners.

The sedimentary rocks have a regional dip of 30 to 35 ft. per mile to the south. Superimposed on this regional dip are folds of varying size; the largest ones are 20 to 30 miles long, 3 to 6 miles wide, and are as much as 200 ft. in amplitude. Most of the zinc ore deposits are associated with small local folds, up to 2 miles in length, in larger synclines.

Over a five-year period a very detailed study of the areal geology, mine workings, and more than 10,000 drill logs has assembled basic data for mapping the structure of the district with a precision heretofore not possible. The detailed geologic structure maps have indicated that the ore-bearing fault zones are on the flanks of the smaller folds, and in turn, these smaller folds are aligned along larger synclines having northeast, northwest or east trends, forming a complex pattern.

The average grade of the ore deposits ranges from 4 to 8% zinc and 0.5 to 1% lead. The orebodies are 50 to 300 ft. wide, 1,000 to 5,000 ft. long, and 10 to 125 ft. thick; the range in volume from 100,000 to 500,000 tons, but a few contain 3,000,000 tons. Mining is usually on one level. Skip hoisting instead of the old time cans will be used by Calumet and Hecla Consolidated Copper Co. and Eagle-Picher Mining and Smelting Co. An incline for truck haulage will be used at the Bautsch mine of Tri-State Zinc, Inc.

At present the trend is toward the operation of flotation mills at the mines and a number of companies, such as the Dodgeville Mining Co., Calumet and Hecla Consolidated Copper Co., Eagle-Picher Mining and Smelting Co., and Tri-State Zinc, Inc., have flotation mills at their respective properties. The capacity of these mills ranges from less than 100 to 1,200 tons.

In general, the future of the district appears to be favorable. The recent discoveries have been confined to a relatively small area of the district, but there is no reason to suppose that other workable deposits of zinc and lead ore do not occur throughout the rest of the district. Furthermore, it is possible that ore occurs in the Prairie du Chien group, which lies below the St. Peter sandstone. Ore is known in these beds in the northern part of the district where they are exposed at the surface, but to date no systematic exploration has been done in these rocks.

Bunker Hill Modernizes Mine, Mill and Smelter

PURPOSE OF THE BLOCK-CAVING PROJECT

"In order to supplement and eventually replace the old jig tailings which have been reclaimed and processed during the past four or five years, arrangements are being made to mine by block-caving methods certain low-grade ores in the hanging wall of mined out areas on the upper levels of the mine. Such mining is expected to commence about the middle of the year. Exploration for additional low-grade reserves continues to be encouraging."

J. B. HAFFNER, Vice President and General Manager, Bunker Hill & Sullivan Mining and Concentrating Co., Kellogg, Idaho.

IMPROVEMENTS NOW UNDER WAY at the Bunker Hill & Sullivan operations in the Coeur d'Alene district are part of a forward looking program to increase capacity and efficiency of the mine, mill and smelter. Articles in recent years have described the zinc fuming plant, the new underground hoist, and the modernized mine electrical distribution system. Interest is now centered in the block-caving section of the mine mentioned in Mr. Haffner's foreword and illustrated on the next two pages, and the following installations in the smelter and mill:

The Smelter

Certain changes and additions became necessary at the Bunker Hill smelter to keep abreast with increased production from mines in the area and to handle additional zinc plant residues produced in the newly-completed fourth unit of the Sullivan Mining Co.'s electrolytic zinc plant.

As at most lead smelters, the sintering plant is the bottleneck of the operation. Presently the Dwight and Lloyd plant consists of 10 standard sintering machines. Because of the poor condition and inadequate capacity of the Cottrell precipitator to handle all gases efficiently, the D&L plant cannot now be operated at full capacity.

A pilot Ultrasonic precipitation unit for agglomerating and recovering dust and fume from the D&L gases is practically ready for its initial operation. If the experiment proves successful, a unit of ample capacity to handle all D&L gases will be erected.

A new D&L charge preparation plant is also in the planning stage. This plant should make possible a more thorough mixing and nodulization of the D&L charge and increase the tonnage which can be handled by each D&L machine. It should also produce a better grade of sinter for more satisfactory blast furnace operation. All changes and improvements in charge preparation and D&L operation are being made with a view to possible manufacture of sulphuric acid from D&L gases.

A furnace for the continuous softening of lead bullion has recently been completed. This process originated with Broken Hill Associated Smelters Proprietary, Ltd., Port Pirie, Australia. The new furnace is 5x15 ft. After the experimental stage, it will replace two batch softening furnaces.

In 1943, a $1,500,000 slag-fuming plant was added to the smelting unit. Since then, approximately 1,500 tons of zinc per month, as zinc oxide fume, have been produced from blast furnace slag and dump slag. When this plant was started, more than one million tons of slag assaying approximately 11% were available in the dump for processing—potentially a nice zinc mine on the surface.

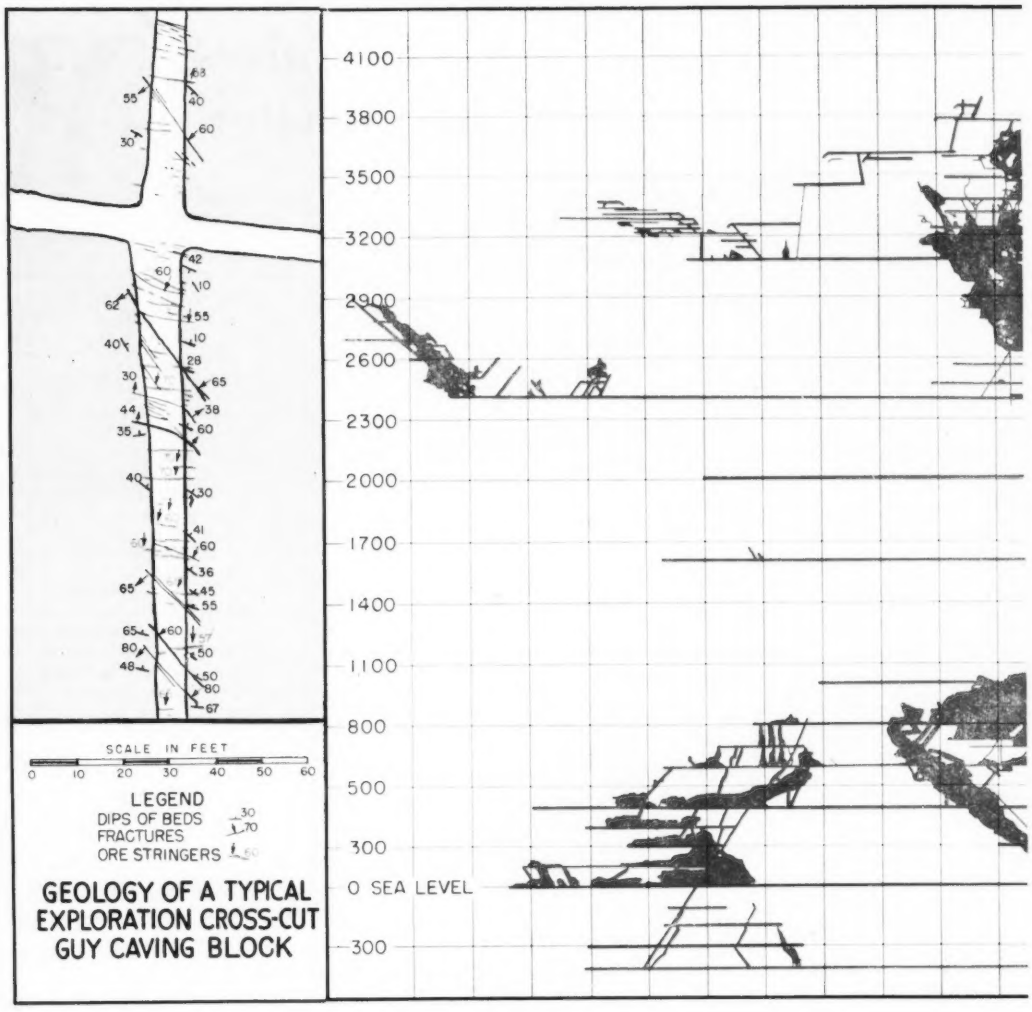
The Mill

Construction and equipment installations during 1948 have been largely directed toward increasing mill capacity from 1,800 to 3,200 dry tons per 24 hr. This has necessitated replacing small units with larger ones in the new mill building completed in 1947. Some of the recent changes made are as follows:

The primary grinding section now includes two 10 ft. 6 in.x8 ft. ball mills in addition to the two former 6 ft.x36 in. Hardinge-type ball mills. Original lead and zinc rougher circuits each consisted of 14 48-in. Agitair flotation machines. Two more 14-cell banks will be added to handle increased capacity in these rougher sections. Capacity of the mill-feed screening section to size sink-float feed is being increased by replacing two 4x14-ft. vibrating screens with three 5x14-ft. Allis-Chalmers low-head vibrating screens. A 4-ft. Esperanza-type drag classifier has been installed to dewater screen undersize in addition to the two original units, and an additional 40-ft. Dorr thickener has been installed to thicken the Esperanza overflow.

An important improvement in metallurgy has been obtained by changing grinding practice. The new method is based on the fact that rock particles classify themselves into several ore fractions differing in specific gravity hardness, size, metallic content, etc.; and that optimum metallurgy on all of these fractions cannot be obtained by operating under conditions which give optimum metallurgy for any one fraction. Hence the ore is first subjected to a superficial or "flash" primary grind.

Flotation of lead and zinc follows this grind. Zinc rougher tailings are classified, the slime fraction being rejected, and the sands being reground and retreated by flotation in the same circuit. A portion of the lead rougher concentrate and a portion of the zinc rougher concentrate are also reground and then retreated by flotation in this circuit. The purpose of this procedure is to keep all ore particles in the pulp stream at a size at which they are controllable as regards classification and flotation, and to segregate them so as to permit grinding and classifying particles in the same gravity and hardness range. The final objective is to grind and classify each rock particle to the size required for optimum metallurgy. Full adherence to this plan is expected as soon as sufficient mechanical equipment is installed to carry it out.



Bunker Hill's New Block-Caving Project to Recover Low-Grade Ore

BEFORE THE PRESENT block-caving program at Bunker Hill could be started, members of the technical and operating staffs had to determine the extent and grade of low-grade zinc-lead ores in the old workings of the mine designated as the Guy Caving area. (See longitudinal section at right.) Exploration and sampling was started in mid-1946 and the program continued through 1947, by which time sufficient reserves were discovered to justify block caving of this ore.

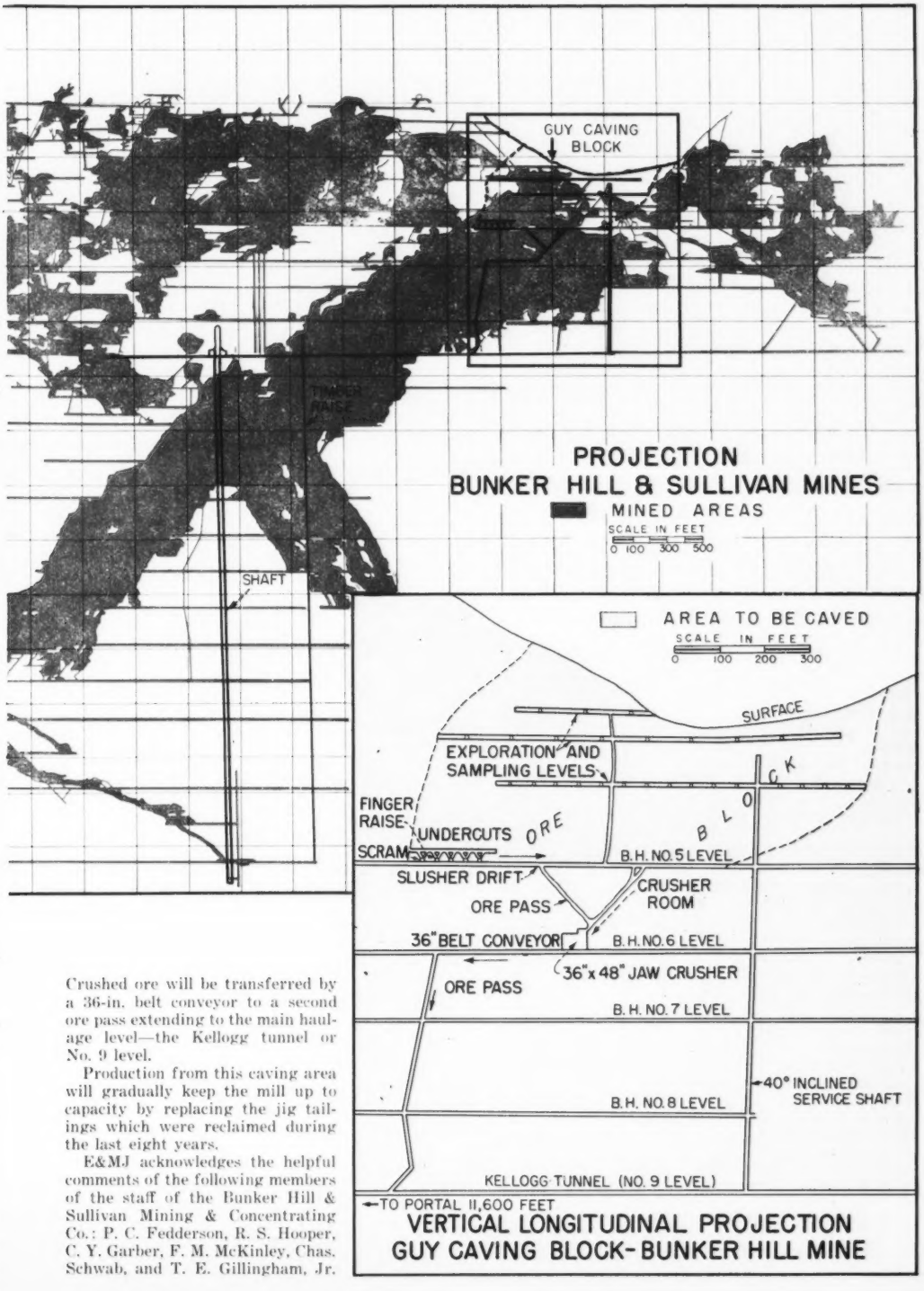
In the geologic sketch of a typical exploration crosscut shown above, note that the deposit is not a disseminated one, but rather a well oriented stringer zone. These stringers consist of pyrite, sphalerite and galena with minor quartz. They vary in width from $\frac{1}{4}$ in. to 6 in., and are concentrated along the zones of fracture in the hanging wall of the Cate fault—the principal structural feature of the Bunker-Hill mine along which the old high-grade lead stopes were mined.

Why Caving Will Work

Also note in the above geologic sketch that the caving area is cut extensively by fractures lying in numerous intersecting planes. These fractures will enable the ground to break up and cave readily as broken ore is withdrawn from the block.

How Ore Will Be Caved

Development work for blocks to be caved above the Bunker Hill No. 5 level is shown in the illustration at right. Ore will be caved by means of undercuts connecting to scram drifts through finger raises. From the scram drifts, the ore will be scraped to an ore pass leading to an underground crusher room housing a 36x48-in. jaw crusher.



Crushed ore will be transferred by a 36-in. belt conveyor to a second ore pass extending to the main haulage level—the Kellogg tunnel or No. 9 level.

Production from this caving area will gradually keep the mill up to capacity by replacing the jig tailings which were reclaimed during the last eight years.

E&MJ acknowledges the helpful comments of the following members of the staff of the Bunker Hill & Sullivan Mining & Concentrating Co.: P. C. Fedderson, R. S. Hooper, C. Y. Garber, F. M. McKinley, Chas. Schwab, and T. E. Gillingham, Jr.

EASTERN STATES PRODUCING ZINC include New York, New Jersey, Virginia and Tennessee. Pennsylvania will be a producer.

BALMAT. St. Joseph Lead Co.'s properties at Balmat and Edwards, N. Y., produce about 5% of the nation's zinc.

Eastern Zinc Mines Modernize

ALTHOUGH ZINC MINING dates back 100 years in the Eastern States, few people realize that one-quarter of the nation's mine production of recoverable zinc still comes from this area. New reserves are being developed, abandoned operations are being re-opened, and smelter capacity is being enlarged not only to treat the concentrates from this area, but from Canada and other foreign sources.

Where is all of this zinc coming from? The answer lies in part in the following accounts of the activities of various mining companies in this area.

BALMAT AND EDWARDS—Approximately 5% of the nation's zinc production last year came from the St. Joseph Lead Co.'s Balmat and Edwards properties situated in northern New York west of the Adirondacks. Principal sulphides are pyrite and sphalerite with minor amounts of recoverable galena at Balmat. Underground operations at both properties are equipped with modern mechanical units for drilling, scraping, loading and hauling.

A 1,250-ton flotation plant at Balmat produces principally zinc concentrates with a like tonnage of iron concentrates and a minor amount of lead concentrates. Capacity of the Edwards mill is 400 tons when operated on a 16-hr. basis. This mill produces only zinc concentrates. During 1948, zinc concentrates produced by these properties totaled 62,777 tons. These were shipped to the electrothermic zinc smelter at Josephtown, Pa.

THE FRANKLIN-STERLING AREA—Fifty miles northwest of New York, in the Franklin-Sterling area of New Jersey, lie large orebodies which have been the subject of study since the Dutch discovered Nieuw Amsterdam. Since zinc mining began in this country approximately 100 years ago, this area has been the largest zinc ore producer in the east. Activity originally centered at Mine Hill (Franklin) where freedom of the ore from lead, cadmium and arsenic made it possible to produce slab zinc of unique purity with smelting methods of the early days. Outstanding performance of this high-purity zinc encouraged technical developments which today make it possible to produce high-grade and special high-grade zinc from complex ores.

The Mine Hill operation has long been a fully integrated model property, but the recent replacement of the boiler house should be recorded as a major improvement in power facilities there. New construction at Sterling Hill at present includes a new shaft, headframe, hoist and compressor house and milling equipment, all of which will provide facilities for increased production.

Exploration and development of the orebody indicated the need for a new shaft which will be located entirely in the footwall of the orebody. Preliminary excavation of an 8x8-ft. pilot raise has been completed from the 1,850-ft. level to the surface. This will be enlarged to 8x30 ft., and the completed shaft will contain five compartments. Ore will be hoisted in 6-ton skips. Steel sets, rails, piping, etc., are now being installed in the new shaft. In addition, new equipment will be added to the mine, including cars, electric locomotives and drilling units.

A new 100-ft. headframe has been constructed and the necessary equipment will be added soon. The hoist and compressor house has been built, and one of the two hoists has been installed. It is expected that the entire project will be completed by 1951.

FRIEDENSVILLE—Although ore was discovered at Friedensville, Pa., more than 100 years ago, the property has been inactive for more than 50 years. New

FRANKLIN. The Franklin-Sterling area in New Jersey has been foremost producer of eastern zinc for nearly 100 years.

STERLING. Facilities for increased production here will include a new shaft, hoists and modern mining equipment.

Jersey Zinc Co. came into possession of the property about the turn of the century, and subsequent history up to 1948 had been one of prospecting, drilling and continued study. In 1941 enough was known about the Friedensville property to justify development. But before final plans could be made, World War II started and made it inadvisable to divert manpower and materials to this development.

After the war, final drilling was done to test the rock at the site chosen for the new shaft. Because of water conditions close to the surface, it was necessary to employ grouting at various levels and to encase the entire shaft in 12 to 18 in. of concrete. At this writing the shaft has reached a depth of more than 200 ft., and the most difficult area has been passed. Future work should proceed rapidly to the ultimate depth of 1,250 ft.

After the shaft is completed, 12,000 to 15,000 ft. of underground levels and raises will have to be driven in hard rock. Mining will be done with modern equipment including mechanical shovels, electric-powered scrapers, and heavy electric locomotives for hauling ore. Ore will be crushed underground at the foot of the shaft, then hoisted and transferred to a modern flotation mill. The mine is expected to be producing by 1951.

AUSTINVILLE—In southwest Virginia, close to the borders of North Carolina and Tennessee, lies one of the oldest mining properties in the United States. It was an important source of lead during the War of Independence. When the Confederate Government was formed, it realized that the only available source of lead within its borders was this mine at Austinville, and the old shot tower still stands.

Following the Civil War, attention was directed to the zinc ore which was abundant, but never utilized. The New Jersey Zinc Co. acquired this property at the turn of the century and it has been actively worked for years.

As the result of extensive drilling, an extension of the orebody was found, and the shaft is now being deepened. Construction is nearly complete on the Van Mater shaft, going from the 700 to the 1,300-ft. level. A new underground crushing station will handle deeper ores. Mining procedures have been generally improved by the recent installation of mucking machines, jumbos and slushers.

Surface improvements include a new modern filtering and drying plant for concentrates (see E&MJ, March, 1949), new ball mills, and new flotation units to replace less efficient equipment for separating lead and zinc concentrates. All this construction will result in some increase in capacity.

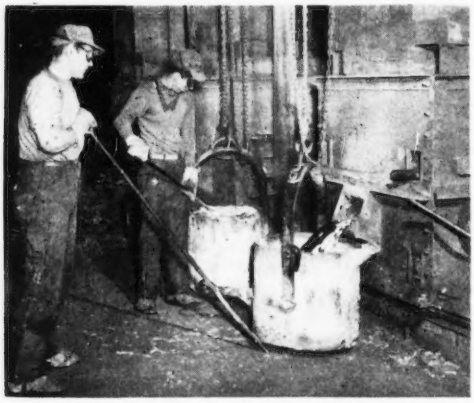
PALMERTON SMELTER—The Palmerton works of the New Jersey Zinc Co. (of Pa.) is adjacent to the anthracite coal fields of eastern Pennsylvania and convenient to the Franklin-Sterling Hill mines for the smelting of whose ore it was originally built. Its location is also favorable to sources of other ores in eastern United States and to ports of entry for imported ores. Chief products of this smelter are slab zinc (both high grade and special high grade), spiegeleisen, cadmium, sulphuric acid, zinc oxide of various types, and a range of zinc sulphide pigments.

Development work on the company's vertical retort smelting method and zinc refining processes was done at Palmerton. The usefulness of the vertical retort process demonstrated by nearly 20 years of commercial operation has now been increased by the development of a new and more efficient condenser described in E&MJ, March, 1949. Most of the primary slab zinc produced at Palmerton is refined into special high grade.

The Palmerton plant is strategically located to serve the industrial area east of Cleveland, and another plant at Depue, Ill., serves the industry farther west.

JOSEPHTOWN SMELTER—Expansion in capacity at the Josephtown Electrothermic Zinc plant now being completed at Josephtown, Pa., by the St. Joseph Lead Co., was timed just right to offset the shutdown

JOSEPHTOWN. An expansion program costing about $8,000,000 now being completed at the St. Joseph Lead Co.'s electrothermic zinc smelter at Josephtown, Pa., will increase the processing capacity of the plant to 600 tons of zinc concentrates per day.

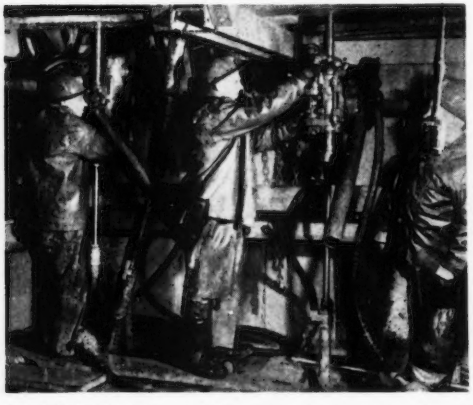


PALMERTON. Most of the slab zinc produced at New Jersey Zinc Co.'s Palmerton plant is refined into special high grade.

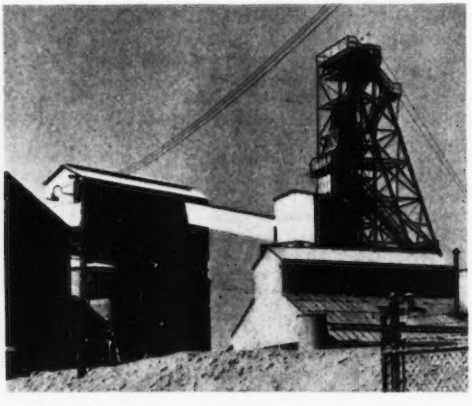
of other obsolete retort plants during the past few years in the Eastern states.

When first completed in 1930, the Josephtown plant was designed to process 120 tons of concentrates per day to produce zinc oxide. With added equipment, the plant started to produce slab zinc in 1936, and by 1940 the processing capacity of the plant was brought up to 300 tons of concentrates per day. As the result of a postwar expansion program now being completed and costing about $8 million, the Josephtown plant will have a daily capacity approaching 600 tons of concentrates and will produce 100 tons of zinc oxide, 500 tons of sulphuric acid, and 220 tons of metal of various grades. The smelter will be able to treat the entire production of zinc concentrates from the company's Balmat and Edwards mines, plus even greater quantities from other domestic and foreign sources.

EASTERN TENNESSEE. Additional tonnages of zinc, amounting to approximately 4.7% of the nation's total mine production of zinc, are produced at the well-known operations of the American Zinc Co. and the Tennessee Copper Co. in eastern Tennessee.



FRIEDENSVILLE. Diamond drillers prepare for grouting in the new shaft at Friedensville, Pennsylvania's coming zinc producer.



AUSTINVILLE. Underground and surface operations at this Virginia zinc-producing property are being extended and modernized.

RECENTLY INSTALLED FUMING PLANT at AS&R's smelter near El Paso, treats zinc-bearing slag from lead blast furnace.

Fuming Plant Treats 12% Slag

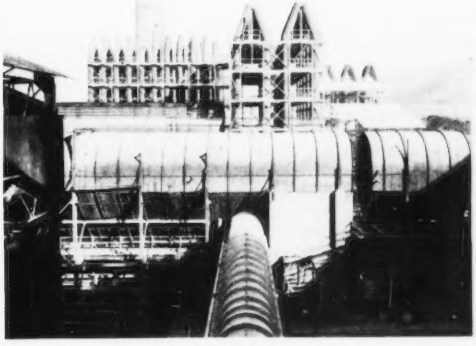
COMPLETION of one year's operation of the American Smelting & Refining Co.'s zinc fuming plant at El Paso further substantiates the value of this relatively new process to recover zinc contained in slag.

About 650 tons of slag are processed daily at the El Paso plant. The slag is obtained from the lead blast furnace and averages 11 to 12% zinc. Approximately 3,000 tons of fume, containing 70 to 74% zinc and 4 to 6% lead, are produced every month. After being de-leaded in rotary kilns, the fume runs approximately 2% lead.

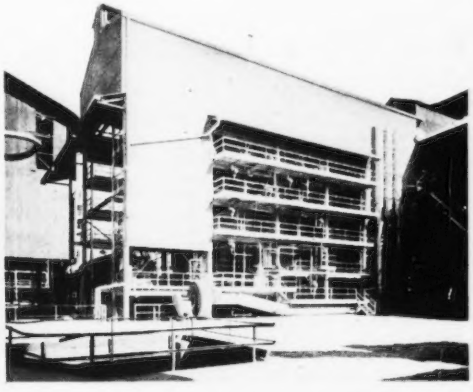
Slag is treated in a water-jacketed furnace. Gases from the furnace go to a waste heat boiler and thence through a steel flue to a system of cooling tubes. From there, the gases pass through a baghouse built in eight sections with 160 bags per section. Finally, they go to a 300-ft. concrete stack. Three 200-hp. fans handle the gases.

Zinc dust is collected from the baghouse, flues, and boiler and cooler tubes, and transferred by conveyors to two 60x8-ft. revolving kilns. By the addition of 1% coke to the kiln feed, lead is reduced from 5% in the raw fume to about 2%. At the same time, the fume is clinkered into a dense product.

Raw fume from the baghouse may be marketed directly as a pigment, or as a raw material for lithopone manufacture. It may also be mixed with dust from the flues and de-leaded for smelting in zinc retort plants.

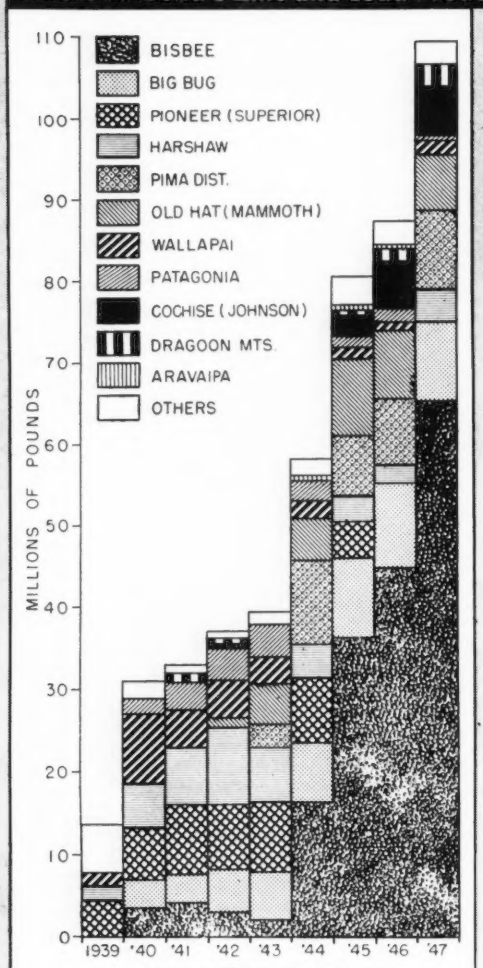


TUBES FOR COOLING zinc fumes have 60,000 sq. ft. of surface.

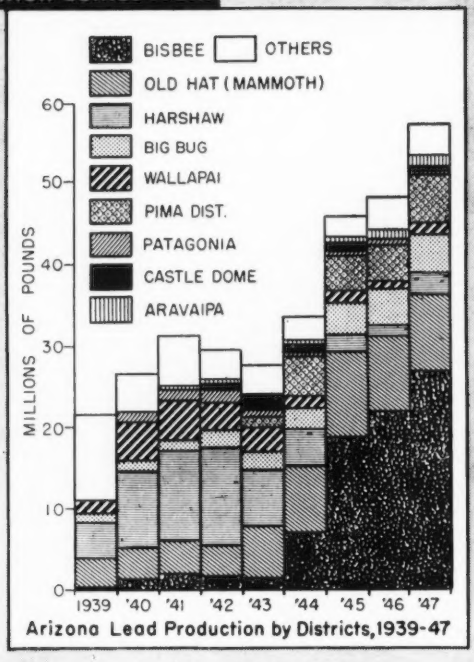


WASTE-HEAT BOILER steam drives generator producing 5,000 kw.

Where Arizona's Zinc and Lead Production Comes From



Arizona Zinc Production by Districts, 1939-47



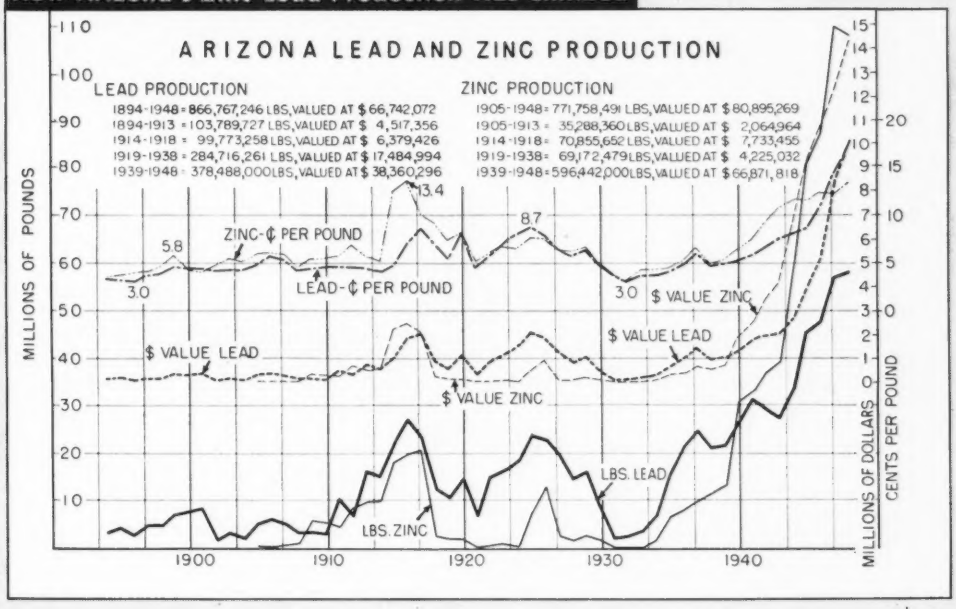
Arizona Lead Production by Districts, 1939-47

Index Map of Arizona Zinc and Lead Districts
Map Numbers Refer to Table Below

Percentages of Arizona's total zinc and lead furnished by 24 districts

Map No.	District	ZINC Percent of total 1905-47	ZINC Percent of total 1939-47	LEAD Percent of total 1894-1947	LEAD Percent of total 1939-47
1	Bisbee	28.6	35.8	29.2	25.3
2	Wallapai	19.9	5.8	8.5	6.8
3	Harshaw	6.7	9.2	7.8	17.1
4	Old Hat	5.4	7.3	8.2	18.5
5	Oro Blanco	5.7	1.2	6.7	2.8
6	Big Bug	8.5	11.6	3.7	7.3
7	Pima	6.0	7.7	3.5	6.4
8	Superior	7.3	9.6	0.4	
9	Tombstone			6.1	1.0
10	Patagonia	3.5	4.0	1.6	2.3
11	Banner	0.7	0.7	4.2	1.8
12	Eureka	2.0	1.0	0.8	1.0
13	Johnson	2.3	3.1		
14	Aravaipa	0.4	0.3	1.8	1.4
15	Castle Dome			2.2	1.7
16	Dragoon Mts.	0.8	1.0	0.7	
17	Mineral Creek			1.0	0.2
18	Osborn			1.0	0.3
19	Empire			0.8	
20	Chiricahua			0.8	
21	Swisshelm			0.7	1.6
22	Silver			0.6	
23	Pine Grove	0.5	0.4		
24	Cedar Valley	0.4	0.5		
	TOTALS	98.7	99.2	90.3	95.5

How Arizona's Zinc-Lead Production Has Climbed



New Orebodies Help Raise Arizona's Lead-Zinc Output

ELDRED D. WILSON, Geologist, Arizona Bureau of Mines, University of Arizona, Tuscon, Ariz.

ARIZONA RANKED FIFTH in zinc and fourth in lead production within the United States for 1946, and third in zinc for 1947.[1] Arizona's output of zinc and lead has increased remarkably since 1933, as shown above. In 1948 her production of zinc was 8 times and of lead 2.7 times greater than in 1939, whereas the yield of these metals for the United States as a whole was less in 1948 than in 1939.

Of the approximately $4,350,000,000 value of all minerals produced in Arizona prior to 1949, zinc has constituted 1.9% and lead 1.5%; for 1939-48, however, zinc amounted to 5.5, and lead 3.1% of the total. Zinc supplanted gold as Arizona's second most valuable metal product during 1944-48, and lead took third place over silver during 1945-48.

Production by several of the leading districts for 1939-47 is shown on the opposite page.

The percentages of Arizona's total output by districts are listed in the table.

As shown in the map, the principal zinc and lead districts are in the southwestern half of the State. Like other metal districts, they occur in the Basin and Range province, within a belt of relatively intense deformation and igneous intrusion, subparallel to the margin of the Plateau.[2]

GEOLOGY. Most of the zinc and lead deposits may be classed as replacements. They range from irregular masses, mantos or "chimneys" to tabular or vein-like forms. Simple fissure fillings appear to be of minor importance.

The largest and most productive bodies of zinc and lead have been found in limestone, as in the Bisbee, Pima (San Xavier), Patagonia, Johnson, Dragoon Mountains, Empire and Swisshelm districts. The next most important deposits of zinc occur in pre-Cambrian gneiss, schist and intrusives, as in the Wallapai, Big Bug, Eureka (Bagdad), Pine Grove and Cedar Valley districts; however, they have yielded less lead than the deposits associated with younger intrusive rocks and breccia, exemplified by the Harshaw, Old Hat and Oro Blanco districts.

BISBEE. Bisbee, Arizona's leading copper district from the standpoint of total output, was worked originally for lead carbonate ore in the late 'seventies. After producing considerable lead during 1908-30 and some zinc during 1917-27, the district by 1938 was not known to have any important resources of

COMBINED PRODUCTION of several mining operations like Iron King, at Humboldt, assure Arizona's future as lead-zinc producer.

sphalerite or galena. In 1939, however, zinc production was resumed. Zinc and lead ores were sent to the Shattuck Denn and other custom plants until in 1945 when Phelps Dodge Corp. built its present zinc-lead concentrator, now of 900 tons daily capacity. During 1945-48 the district yielded more zinc than copper and ranked as the foremost zinc-lead producer in the State. In 1947 it furnished more than half of the total zinc and almost half of the total lead output of Arizona.

HARSHAW. American Smelting and Refining Co. in 1939 completed a flotation plant of 200 tons daily capacity at the Trench mine, south of Patagonia. Operations at the Trench, Flux and other mines raised the district to first rank in Arizona lead production for 1940-43 and first in zinc for 1942.

OLD HAT. The Mammoth area, immediately north of San Manuel, was worked originally for gold, vanadium and molybdenum. Mixed sulphide ores were first developed in 1943. Ore treated in the St. Anthony Mining and Development Co. mill of 350 tons daily capacity in 1947 averaged 0.013 oz. of gold and 1.16 oz. of silver per ton, 0.42% copper, 5.95% lead, and 6.46% zinc.[3]

BIG BUG. The Iron King mine was worked chiefly for gold and silver until 1937 when Iron King Mining Co. began development of the zinc-lead ores. A flotation concentrator was built in 1938 and enlarged to a capacity of 470 tons per day by 1947. Since 1942 the property has been operated by Shattuck Denn Mining Corp. In 1947 the mill treated ore averaging 0.124 oz. of gold and 4.335 oz. of silver per ton, 0.17% copper, 2.54% lead, and 6.95% zinc.[3]

PIMA. In 1943 Eagle-Picher Mining and Smelting Co. built a concentrator at Sahuarita and reopened the old San Xavier mine. The concentrator, later enlarged to a capacity of 400 tons per day, has taken care also of considerable custom ore. In 1947 it treated ore averaging 2.727 oz. of silver per ton, 0.511% copper, 5.881% lead, and 10.229% zinc.[3]

SUPERIOR. The Magma, one of Arizona's great copper mines, was an important producer of zinc during 1937-45 and the largest of zinc in the State for 1943. Its zinc mining was terminated in 1945 owing to labor shortages and subsequently has been delayed pending construction of a new concentrator.

JOHNSON. The principal mines of the Johnson copper district have been owned since 1942 by Coronado Copper and Zinc Co., which in 1944 built a flotation plant of 150 tons daily capacity. Ore treated in 1947 contained an average of 0.40 oz. of silver per ton, 1.67% copper, and 6.10% zinc.[3]

BANNER. The Seventy-Nine mine was reopened in 1940 by Shattuck Denn Mining Corp. This corporation has shipped the zinc-lead ore chiefly to its concentrator of 150 tons daily capacity in Bisbee, which in 1947 handled also zinc ore from the Abril mine northeast of Tombstone and zinc-copper ore from the Antler and Copper World mines near Yucca.

ARAVAIPA. Athletic Mining Co. began developing orebodies in the northern part of this district in 1942. Its new concentrator of 100 tons daily capacity has been in operation since early 1948.

POSSIBILITIES. The current recession already has discouraged operations at some of the properties. Unlike the porphyry coppers, the known deposits of zinc and lead in Arizona are not amenable to low-cost mining. Transportation and recovery costs are high, particularly for zinc.

As implied in the foregoing discussion, most of the Arizona zinc and lead production since 1939 has come from orebodies previously unknown or undeveloped. With metal prices favorable in respect to operation costs, exploration and development have made possible the record production. In all probability, additional orebodies will be found and developed in old and new districts if warranted by demand and market value.

(Editor's Note.)

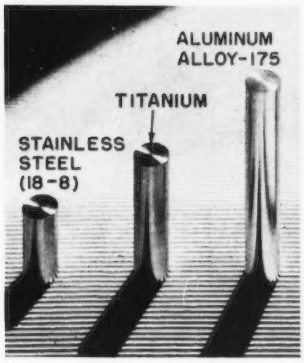
This splendid record strongly suggests that for future domestic sources of lead and zinc, the nation may well look to Arizona as one of its likeliest areas for prospecting.

(1) Figures computed from U. S. Mineral Resources and U. S. Minerals Yearbooks.

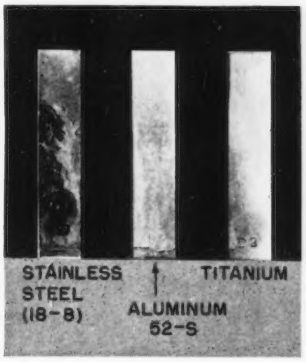
(2) R. S. Butler, Relation of ore deposits of the Southern Rocky Mountain region to the Colorado Plateau: Colo. Sci. Soc., Bull. 12, pp. 30-33, 1930.

(3) U. S. Minerals Yearbook for 1947.

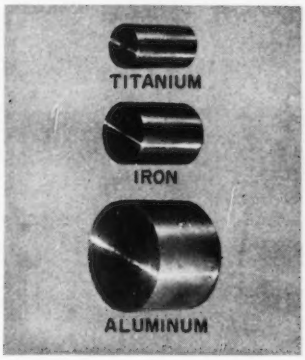
Titanium is light, corrosion-resistant and strong



COMPARATIVE DENSITY of stainless steel, titanium and aluminum is shown by these three bars each weighing one pound.*



600 HOURS' EXPOSURE to salt water corroded stainless steel and aluminum, but titanium metal remained untouched.



TITANIUM'S RELATIVE STRENGTH shown by rods of commercially pure metal having equal tensile strength but varying diameters.

Titanium—The Metal with a Future

THERE ARE MANY REASONS why titanium can be called the metal with a future, even if present developments in research are viewed with cautious optimism. The following are a few compelling ones:

1. Titanium is the ninth most abundant element in the earth's crust, and about four times as abundant as copper, lead and zinc combined.

2. Its potential strength, corrosion and heat-resistant properties and relative light weight fit in neatly with the requirements of modern and future design. Hence an assured market awaits the development of suitable alloys, and this potential demand will increase as new and cheaper methods of production are devised.

3. From a defense standpoint, the qualities of titanium and its alloys are definitely attractive for modern land, sea and aircraft, particularly because North America is now virtually self-sufficient in titanium minerals for many decades.

4. The rapidly growing demand for titanium dioxide (principally from ilmenite, $FeTiO_3$, but also from rutile, TiO_2) serves as an economic springboard which will enable private enterprise to mine and treat titanium minerals and later finance titanium metal production. Domestic demand was so strong that it caused ilmenite production to rise from 20,668 tons in 1940 to 372,000 tons in 1948. Rutile production, chiefly for welding rods, increased from 2,888 tons to 7,100 tons in the same period. In addition, ilmenite imports during 1948 were approximately 250,000 tons. Nearly all of the ilmenite is used to manufacture titanium dioxide for pigments used in paint, rubber, plastics, ceramics, glass, paper, textile, leather and cosmetics, where this white, non-toxic pigment is finding increasing application.

5. Despite present difficulties in the production of pure ductile titanium contributing to high costs, millions are being spent on research with the confidence that current difficulties will be overcome. Rapidly increasing amounts of the metal will soon be placed in the hands of various potential consumers who will multiply the efforts now being exerted to make this metal serve society. The most optimistic observers predict that titanium will take its place among the major metals within the foreseeable future.

A well-informed appraisal of titanium's properties and potential uses is presented in the following comment by a leading research organization:

Why the Great Interest in Titanium?

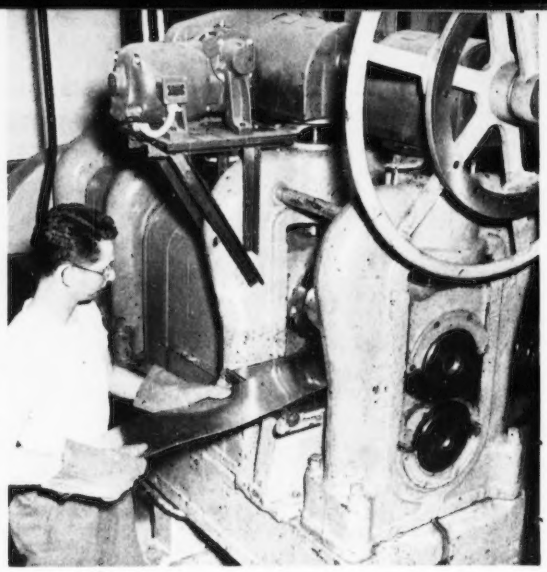
H. C. CROSS, Supervisor, Battelle Memorial Institute

Titanium is of great interest to industry because of its strength and corrosion-resistant characteristics. Wrought titanium of commercial purity shows tensile and yield strengths in the range of 90,000 to 100,000 psi., and 70,000 to 85,000 psi., respectively. At these strength levels, titanium is not quite as good on a strength-weight basis as the strongest magnesium and aluminum-base alloys. Considerably higher strengths can be obtained by either cold working or alloying of titanium metal, and at these higher strength levels, titanium is superior to light alloys and to heat-treated alloy steel. Alloys have been developed at Battelle Memorial Institute in the range of 175,000 to 200,000 psi. with elongation of 3 to 8%.

Titanium and titanium alloys show considerable promise for use at moderately elevated temperatures in the range of 400 to 800 deg. F. Here they show creep strength properties intermediate between those of the light alloys and those of steel. In this temperature range, one possible use for titanuim alloys may be as blading in axial-flow compressors for jet aircraft engines.

Titanium is completely resistant to corrosion in marine environment. In this respect it is equal to stainless steel. Because of its high strength, low weight, and corrosion resistance, considerable use may re-

*Photo at left by Crane Research Laboratories. Center and right photos by Remington Arms Research Laboratories, affiliate of E. I. du Pont de Nemours & Co.



HOT TITANIUM INGOT is removed from furnace preparatory to forging and rolling (right) at Remington Arms Bridgeport Laboratories. Chemical, petroleum, food, aircraft, textile, electrical, power and automobile industries are interested in uses of titanium.

sult in marine applications. The corrosion resistance of titanium in certain chemical environments may also recommend its use rather widely to the chemical industry.

Research on titanium is proceeding rapidly, but much needed information is still lacking. As more is learned about its characteristics and properties, extensive uses for titanium and its alloys will become apparent.

Titanium Not a New Metal

Much of the recent interest in titanium stems from a U. S. Bureau of Mines report[1] published in 1946 which described a successful pilot-plant process for the reduction of titanium tetrachloride with magnesium in a closed furnace under a helium atmosphere. This process was a modification of Dr. Wilhelm Kroll's process developed in Germany 17 years ago. Samples of titanium distributed to the military near the close of the war created immediate interest because of resistance to salt water corrosion and possibilities for application in jet engines and aircraft construction.

However, titanium is not actually a new metal. It was discovered in 1791, and successful attempts to produce pure metal date back to 1887. More than 40 years ago Dr. Matthew Hunter, now Dean Emeritus of Faculty of Rensselaer Polytechnic Institute, was engaged by General Electric, and Titanium Alloy Manufacturing Co. to study titanium. He succeeded in producing titanium 99.7 to 99.9% pure by reducing it from the tetrachloride with sodium in an iron bomb.

[1] U.S.B.M. I.C. 7381, "Metallic Titanium and Its Alloys."

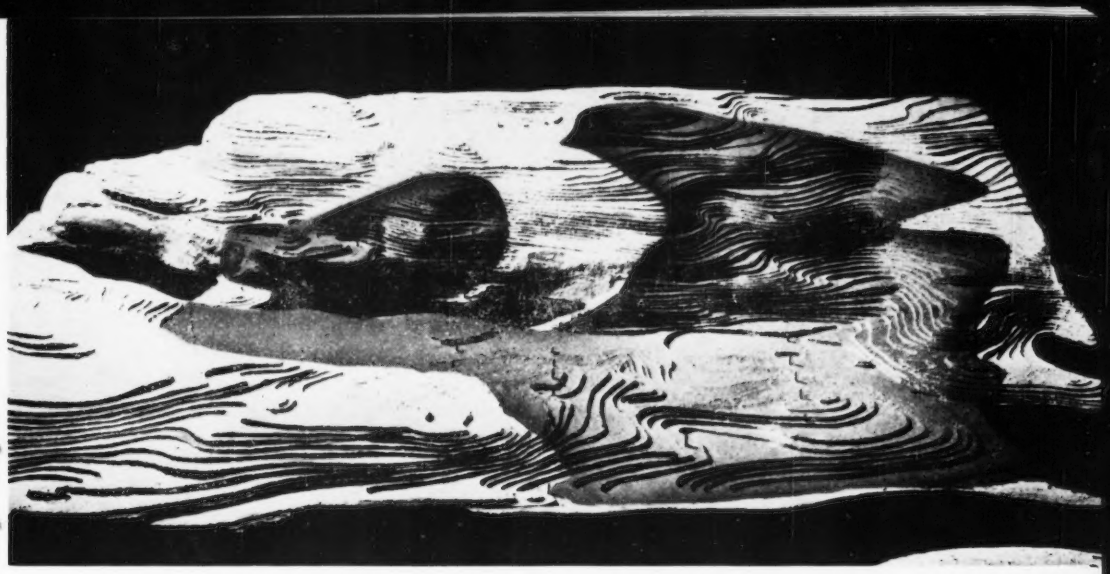
Titanium Alloy was founded in 1906 after Dr. A. T. Rossi developed methods to produce ferro-titanium alloys from MacIntyre ores of New York State. Dr. Rossi also demonstrated the opacity and pigment possibilities of TiO_2 and developed chemical and smelting methods to produce the oxide from ilmenite. During the past 40 years the pigment industry expanded, but the metal failed to attract wide attention even though exhibited at a Chicago Fair in 1919. Titanium Alloy Manufacturing Division of the National Lead Co. has been offering titanium metal on the market for the past 15 years. *E&MJ Metal & Mineral Markets* quotes titanium metal, 96 to 98% pure, at $6 to $7 per lb. on Nov. 1, 1934.

The intensity of titanium research today indicates that a race is on to produce the metal economically, and whoever gets there first with the cheapest will be in an enviable competitive position for a vast new market. Industries interested in the possibilities of titanium and its alloys include the automobile, chemical, textile, electrical, aircraft, marine, power, food, petroleum to mention a few.

Companies active in the field include E. I. du Pont de Nemours & Co., which offers ductile titanium from pilot-plant production at $5 per lb. Remington Arms Co., a du Pont affiliate, is also making ductile titanium. (See illustrations.) Titanium Alloy Manufacturing Division of National Lead Co. is increasing facilities to make the metal at the Niagara Falls plant, where output will be expanded several hundred percent in the near future. Present objectives are to supply the metal to various industries interested in knowing more about the properties and uses of titanium.

New Jersey Zinc and Kennecott Copper Corp. are doing research on metallic titanium, and Dominion Magnesium of Canada has developed a process to produce ductile titanium. Others engaged in titanium research include Battelle Memorial Institute, which is conducting a major project for the Government and private industries. General Electric and Westinghouse are studying alloys of titanium, and others active include the Navy, Driver-Harris Co., and P. R. Mallory and Co.

How the metal will be produced eventually on a large commercial scale is still a question. Of the many methods known including electrolysis of fused salts and the direct reduction of titanium dioxide with calcium hydride, the one most favored seems to be the reduction of $TiCl_4$, which is used in both the Hunter and Kroll processes. The reduction of titanium tetraiodide also has definite possibilities. It is



WORLD'S LARGEST KNOWN ilmenite orebody in Allard Lake area of eastern Quebec contains approximately 125 million tons of ore averaging 32% TiO_2. Kennecott Copper Corp., and New Jersey Zinc Co. are developing this property. Dark area is the orebody.

generally agreed that continuous methods will supplant batch methods. Development of an economic commercial process will not be easy, chiefly because titanium has a strong affinity for carbon, oxygen and nitrogen at elevated temperatures necessary to produce it. Small amounts of these contaminants cause serious embrittlement. Furthermore, titanium has a habit of eating its way through crucibles which creates a difficult refractory problem. Finally, titanium when produced in a sponge or powder form must be melted or sintered to convert it into sheets and other shapes.

How much will titanium cost? Here also the answer depends on whom you ask. All acquainted with the problems agree that the present $5 price will eventually come down. The most optimistic estimates are 50c. or even lower. But others engaged in the work say that these estimates are too low unless a process not now employed be developed. It has been pointed out, for instance, that the cost of raw materials alone to produce one pound of titanium totals about $1.80 in a current batch process. Cheap power and large-scale production are also cited as factors which will help reduce costs.

Sources of Titanium Ore

The final question is: "Where are the raw materials going to be produced?" Ilmenite is the major source of titanium, and fortunately the mining industry has developed abundant reserves as the following review of major sources indicates:

QUEBEC
ALLARD LAKE
(KENNECOTT COPPER CORP. & NEW JERSEY ZINC)
ILMENITE ORE WILL GO TO SOREL BY BOAT
SITE OF NEW ILMENITE REDUCTION PLANT OF QUEBEC IRON & TITANIUM CORP.
SOREL
MONTREAL
TAHAWUS (NATIONAL LEAD CO.)
NY
(AMERICAN RUTILE CORP.)
PINEY RIVER (AMERICAN CYANAMID CO.)
NC
TADKIN MICA & ILMENITE CO. (GLIDDEN CO.)
RUTILE MINING CO.
TRAIL RIDGE (DU PONT)
(HUMPREYS GOLD CORP. OPERATES BOTH FLORIDA PROPERTIES UNER CONTRACT)
FLA

ILMENITE RESERVES in this area assure North American self-sufficiency for decades.

ALLARD LAKE AREA. Discovery of the world's largest known titanium orebody in the Allard Lake area of eastern Quebec is unquestionably the most significant event in recent mining history. Eastern Canada is already witnessing the start of a major mining project at Allard Lake and the construction of a new smelter at Sorel to treat the ores which will supply the Montreal-Hamilton iron and steel industries with substantial tonnages of pig iron, and industries of the United States with titanium-rich slag (about 70% TiO_2). This project will be financed by New Jersey Zinc Co. and Kennecott Copper Corp.

Beyond the immediate heavy demand for TiO_2 in the slag lies the great future potential market for the metal which is expected to materialize when present accelerated research projects reach the goals now set. Because of the strategic importance of ilmenite, it is indeed fortunate for the democratic world that this huge deposit of ilmenite was found in North America.

The new orebody on the shores of Lake Tio (for titanium oxide) and Lake Ano (for anorthosite in which the ore occurs) contains approximately 125,000,000 tons of ilmenite ore averaging 32% Tio_2 and 36% Fe. Reserves of this magnitude could supply the entire United States with ilmenite for more than 100 years on the basis of 1948 consumption, which totaled 372,000 tons of domestically produced ilmenite plus about 250,000 tons of imported ilmenite.

Diamond drilling and surface exposures indicate that the orebody is 3,600 ft. in length and 3,400 ft. in width and occupies an area of approximately 134 acres. In the eastern part of the main orebody, diamond drills have disclosed ore to a depth of 300 ft. and a number of the holes were stopped in ore.[2]

Presence of ilmenite in the Al-

[2] Paul Hammond, Geologist, Kennex, Ltd., Canadian Mining & Metallurgical Bulletin, March, 1949.

NATIONAL LEAD CO.'S MACINTYRE operations at Tahawus, N. Y., mined 1.2 million tons of ore in 1948 producing 250,000 tons of ilmenite, and 500,000 tons of magnetite. Concentrator separates minerals by magnetic, gravity, and flotation methods.

lard Lake area was first reported by J. A. Retty of the Quebec Department of Mines in 1941. Later claims staked by several parties were optioned by Kennco Explorations, Ltd., a Canadian subsidiary of Kennecott Copper Corp., under direction of A. H. Robertson and New Jersey Zinc Co. A major exploration program was started in 1946 involving geologic examination and dip needle traverses. This resulted in the discovery of several ilmenite orebodies ranging roughly from 1,000,000 tons to several million tons. But the major geophysical find was the Lake Tio deposit, which was subsequently diamond drilled to expose reserves sufficient to warrant a major mining program. In 1947 an airborne magnetometer survey was run over 1,000 square miles to complete the study of the area.

A new company, the Allard Lake (Quebec) Mines, Ltd., will conduct the Canadian operations. In the United States, the Quebec Iron and Titanium Corp. will be the operating company. Both companies will be owned by the Kennecott Copper Corp. and New Jersey Zinc Co., with R. J. Parker as president, and A. H. Robertson, vice president in charge of Canadian operations.

Expenditures to develop the Lake Tio deposit and build a railroad, ore dock, storage facilities and the smelter at Sorel (described next) are expected to be about $25,000,000. Although initial revenue will come from the sale of titanium-rich slag and pig iron, it is expected that the deposit will be a major source of titanium minerals for the production of titanium metal when economic methods of production are devised.

SOREL—Quebec Iron and Titanium Corporation's smelter for the reduction of ilmenite ore from the Allard Lake district will be erected at Sorel, 50 miles downstream from Montreal on the south side of the St. Lawrence River. Foundation testing has been completed and the site is now being cleared. Ore will be delivered in cargo boats during the seven months of the year when the St. Lawrence River is open for navigation. A 500-ft. dock will be constructed to accommodate these boats. Ore will be discharged from the ships by a tower unloader to a belt conveyor which will carry it to stock on open ground. Subsequently the ore will be picked up with a reclaiming crane and belt-conveyed to dryers, then crushed, and carried to the mixing plant.

Electric smelting furnaces of the stationary type with six electrodes in line will reduce the ore. These furnaces will each have a capacity for smelting 300 tons of ore per day. Reduction will be a continuous operation. Power will be delivered by Shawinigan Water and Power Co. over a 40-mile transmission line to be built from Three Rivers, involving a crossing of the St. Lawrence to the plant.

It is expected that the Sorel plant will be in full production by the spring of 1952, producing at the annual rate of 175,000 long tons of iron for sale to steel and foundry trades, and 230,000 long tons of titanium-bearing slag (approximately 70% TiO_2) for sale to producers of titanium dioxide.

TAHAWUS. The MacIntyre property at Tahawus, N. Y., comprising some 11,000 acres, was acquired by the National Lead Co. in 1941. The ore occurs in two tabular masses 2,000 ft. long, and varying in thickness up to several hundred feet. Magnetite and ilmenite occur as a massive coarse-grained mixture with very little gangue in some parts, and as a fine-grained disseminated ore in others. The ore averages about 16% TiO_2 and 34% Fe. Ore is mined by open-pit methods. Churn drill holes are 9 in. in diameter and 40 ft. deep. Broken ore is loaded with 2½ to 4-yd. electric shovels and hauled in 15 to 22-ton diesel trucks.

Ilmenite and magnetite are separated in a concentration process involving magnetic separation followed by flotation, and finally sintering of the fine magnetite products. Last year the Tahawus operation moved approximately 2.5 million tons of ore and waste and produced 250,000 tons of ilmenite and 500,000 tons of magnetite containing 57% iron.

ROSELAND, VA. American Rutile Co. is mining a disseminated orebody containing 6 to 10% combined rutile and ilmenite by open-pit methods at Roseland, Va. Ilmenite and rutile concentrates are produced in a plant using gravity,

BARGE-MOUNTED SPIRALS operated by Humphreys Gold Corp. concentrate titanium sands at du Pont's Trail Ridge property.

OPEN-PIT MINE of Calco Chemical Division of American Cyanamid Co. produces about 170,000 tons of crude ilmenite ore per year.

electrostatic and magnetic equipment.

PINEY RIVER OPERATIONS. The nelsonite ore deposit of the Calco Chemical Division of American Cyanamid Co. at Piney River, Va., is a tabular intrusion of igneous origin into the surrounding country rock. Constituent minerals are ilmenite, apatite and ferromagnesian minerals. The deposit is continuous to a considerable depth and is divided into an upper weathered portion of considerable extent which is currently mined, and a lower zone of primary ore underlying all of the upper ore.

Output of the nelsonite ore deposit at this operation is about 170,000 tons of crude ore per year. Ore is mined by open-pit methods combining intermittent movement of ore with Le Tourneau pans to stockpiles with daily removal from stockpiles, with a Sauerman dragline scraper.

Concentration is as follows: The ground nelsonite ore is preconcentrated and deslimed in Humphreys spirals, followed by bulk flotation of the ilmenite and apatite from silicate minerals in Fagergren flotation cells. Apatite is separated from the ilmenite by selective flotation as a froth concentrate. Only ore from the oxidized layer of the orebody is processed at present, but ore from the lower zones can be concentrated satisfactorily by the same method.

FLORIDA OPERATIONS. The Humphreys Gold Corp., largest producer of rutile and zircon in the United States, and the second largest producer of ilmenite, operates the following Florida properties under contract with other companies: (1) A property near Jacksonville, for the Rutile Mining Co., and (2) the new Trail Ridge property for the du Pont Co. near Starke, Fla.

The first operation (see E&MJ, March, 1945) is mined with a suction dredge. Sands are concentrated in three stages of Humphreys spirals. Concentrates then go to a dry mill for the production of rutile and ilmenite. Tailings go through four stages of spirals to produce a concentrate which goes to another dry mill for the production of zircon. Capacity of the plant is about 7,500 tons per day. During the 1944 to 1949 period the Humphreys corporation mined more than 9,000,000 tons of sand at this property.

A similar plant is being operated under contract with the du Pont company at Trail Ridge in the north central part of Florida, for the production of titanium minerals. The ore, consisting of black sands mixed with white sands of the area, is mined by a 20-in. suction dredge operating on an artificial lake. (See illustration.) Sands are pumped to a floating conditioner barge where the organic coating is removed. Several stages of Humphreys spirals, also barge-mounted, then concentrate the titanium minerals. Concentrates are sent ashore to a dry mill for further concentration by electrostatic separators. The final product is shipped to du Pont pigment plants at Baltimore, Md., and Wilmington, Del.

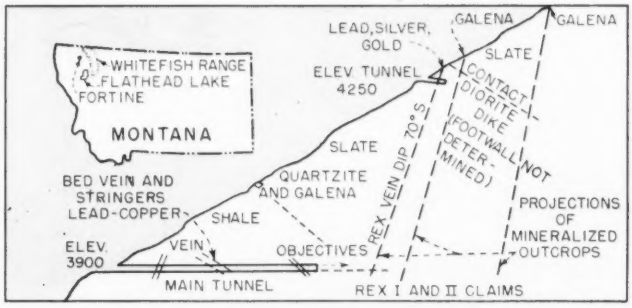
YADKIN MICA AND ILMENITE CO. This property, owned by the Glidden Co., Cleveland, Ohio, is situated near the headwaters of the Yadkin River, about 16 miles north of Lenoir, Caldwell County, North Carolina. The rocks on the property consist of highly altered, partly disintegrated alternate layers of micha schist and gneiss. In this series is the orebody, a layer of ilmenite-chlorite rock having an average thickness of 20 ft. and a known strike of 2,000 ft. It has been explored from its highest point on the surface down the dip for 500 ft., and doubtless extends below this depth.

Average composition of the ore is 50% ilmenite, 40% chlorite, with a minor percentage of rutile.

The property is now producing 30,000 tons of ilmenite per year, averaging 52% TiO_2. Open-cut mining methods are used following removal of overburden with tractors and scraper pans. Mining is done with a Link-Belt Speeder Power Shovel and a Koehring Dumptor. After crushing, the ilmenite is broken down in a Hardinge rod mill to an average size of about 150 mesh. Mica-chlorite and other gang materials are removed by simple washing. Washing and scrubbing is repeated five times. Then concentrates are shipped to the Baltimore division of the Glidden Co. for processing into TiO_2.

Prospects, new mines, and small and growing enterprises, like those presented here, form an important segment in the nucleus of tomorrow's dynamic mining and metallurgical industry

FRITZ W. JAGER



HIS PROSPECT TUNNEL AND OBJECTIVES

THE MOUNTAIN

THE MINE CABINS

THE PORTAL

Mr. Jager Drives A Prospect Tunnel

HERE IS THE SIMPLE STORY of a prospector—just one of many whose courage, hard labor, and perennial optimism have resulted in the discovery of many great mines in the past.

In Lincoln County, Montana, 5½ miles from Fortine on Deep Creek along the south slope of Deep Mt. in the Whitefish Range, Fritz Jager drives a prospect tunnel alone and by hand. His objectives—the projections of several mineralized outcrops on a mountainside. Excerpts from his letters tell the rest:

"In 1926 while digging irrigation ditches for my homestead, I discovered float lead and silver. In 1929 I went looking for a vein along the south slope of Deep Creek Mt. and discovered the Rex vein in June. Up to date I have discovered five veins on my claims along the base of the mountain. At the time of the discovery of the fissure in the diorite dike, a vein sample of the outcrop was assayed, running 55% lead, 22 oz. silver, and a little gold ..... Been driving a crosscut tunnel at my mine since last October [1948]. I am in very hard silicified lime shale about 90 ft. from the fissure [projected] which carries lead, silver and gold, but I may have a 5-ft. bed vein ahead before I get to the fissure. I have 200 ft. of depth now with three fissures [projected] in the next 250 to 200 ft. If I had machinery I could lick this in 30 days. Been developing alone. Run 450 ft. of tunnel. My main tunnel is 370 ft. 5x7 to 5x8-ft. [in size]. Went through a shear zone the last 60 ft. with galena showing. When I get on the other side of this zone, I may be in production. .... I am working 5 days a week for the Forest Service here. Was at the mine Saturday and Sunday and worked in the tunnel. Got some good copper showing on the wall and in the face—malachite and copper pyrite. I am moving toward ore, but can't tell for sure which will show up first, the bed vein or the fissure. ..... I am still 90 ft. or so from Fissure Rex. If I could move ahead with machinery, this mine would be a sitting duck."

FORTINE, MONT. FRITZ W. JAGER

Good luck, Mr. Jager, we hope you strike ore soon.

LOWER COSTS were achieved in this new plant of Feldspar Flotation Corp., Spruce Pine, N. C. Future of process seems excellent.

New Company Floats Feldspar

FROTH FLOTATION is being used for obtaining feldspar, iron-free quartz and fine mica from large dikes of alaskite-granite at a new plant recently placed in commission at Spruce Pine, N.C., by Feldspar Mining Co. and North Carolina Feldspar Corp., which have been mining and refining feldspar for some years in the district. This plant is operated by Feldspar Flotation Corp., a new company.

This is the second feldspar flotation plant to be built in western North Carolina, the first being that of Consolidated Feldspar Corp. at Kona, near Spruce Pine. A third company in the Spruce Pine area has installed flotation equipment in its existing plant. Consolidated Feldspar also has another plant for the same purpose at Parkdale, Colo.

Former Costs Higher

Before the commercial application of flotation to recovering feldspar, the production of this mineral was based on the mining of comparatively limited lenses and irregular streaks of feldspar. Considerable hand cobbing was necessary to free the imbedded quartz and other impurities. Much of the mining had to be done by hand.

As a result, costs were high. As other raw materials became increasingly competitive in some of the manufacturing processes for which feldspar is specially adapted, it was necessary to cut the costs of mining and refining. The deposits of straight feldspar also were being rapidly exhausted in districts from which rail freight rates permit access to the consuming markets.

A Joint Enterprise

This combination of conditions induced the principals of the Feldspar Milling and North Carolina companies to join forces in the formation of Feldspar Flotation Corp. While both of these concerns are in the small business class, each has done a great deal of research. Their joint efforts continued until a practical and economical method of separating the several components that make up the alaskite-granite deposits was developed.

The plant has immediately adjacent reserves sufficient to permit it to run to capacity for 30 years or more. Other large deposits of alaskite-granite are available within easy trucking distance.

Users of feldspar as a raw material are largely manufacturers of white ceramic ware. In recent years, glass makers also have used feldspar increasingly, particularly for making containers. In addition, there are scattered uses, such as for polishing powders.

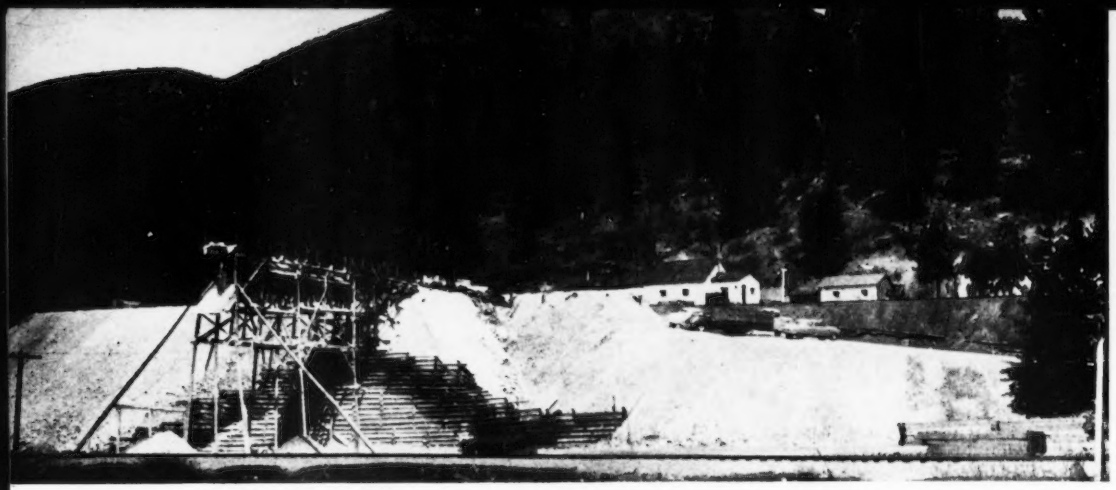
Over the years, the various users of this raw material have learned to work mainly with feldspar that is relatively high in potash. Such a product comes naturally from most deposits of crude feldspar. Most flotation concentrate is much higher in soda. As a result, there was resistance for a time among some white ceramic users to use of the soda-type product.

With the return of competitive conditions, consumers have found rather rapidly that they could use properly-blended soda types with entire satisfaction. As a result, the belief is growing that within a few years the flotation concentrate will largely replace the product ground from relatively pure feldspar. In fact, the remaining deposits of the pure material will not last long. In contrast, there are ample supplies of the alaskite-granite in the Spruce Pine district to meet all foreseeable demands for an indefinite period.

Work on Bigger Scale

Open-pit mining of the large dikes of alaskite-granite permits use of power drills, good-sized shovels, motor truck haulage and other efficient methods. Plant operations also are on a mass-production basis, with machinery and equipment almost entirely eliminating hand labor. The froth-flotation process does away with most of the dust. This is quite a problem in the old methods of grinding and refining the purer feldspars.

Officers of the Feldspar Flotation Corporation are: C. P. Rogers, president; W. F. Deneen, vice-president; C. P. Rogers, Jr., manager, and L. L. McMurray, engineer.



LUCKY FRIDAY ships its ore from the portal. Proceeds from carefully controlled production finance mine exploration and development.

Lucky Friday Mine Pays Its Way As It Develops Ore at Depth

PRUDENT MANAGEMENT of the Lucky Friday mine, near Mullan, Idaho, is making a mine out of prospect by striking a careful balance between development expenditures and revenues received from ore mined. Since the start of operations in 1939 to 1948, inclusive, the Lucky Friday Silver-Lead Mines Co., of Wallace, Idaho, has produced 545,100 oz. of silver, 2,702,000 lb. of lead, 1,078,800 lb. zinc, and 203,000 lb. copper. Proceeds from sales have been used to develop the mine at depth. As a result no dividends have been paid. On the other hand, no assessments have been levied against stockholders for working capital.

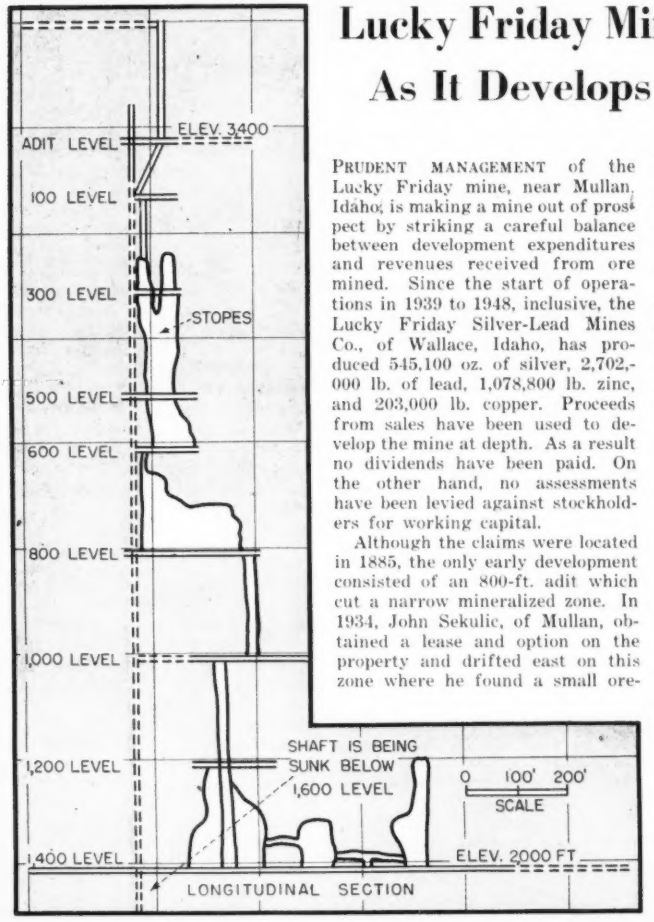
Although the claims were located in 1885, the only early development consisted of an 800-ft. adit which cut a narrow mineralized zone. In 1934, John Sekulic, of Mullan, obtained a lease and option on the property and drifted east on this zone where he found a small orebody. In 1939 the Lucky Friday company was organized with John Sekulic as president and general manager, Charles E. Horning as vice president, and W. J. Emacio, secretary and treasurer.

An underground vertical shaft was sunk in short lifts from the adit. As each level was reached, a crosscut was driven to the orebody, and enough ore mined to finance another sinking campaign. Thus levels were established as shown. The shaft is being sunk with the 2,000-ft. level as an objective.

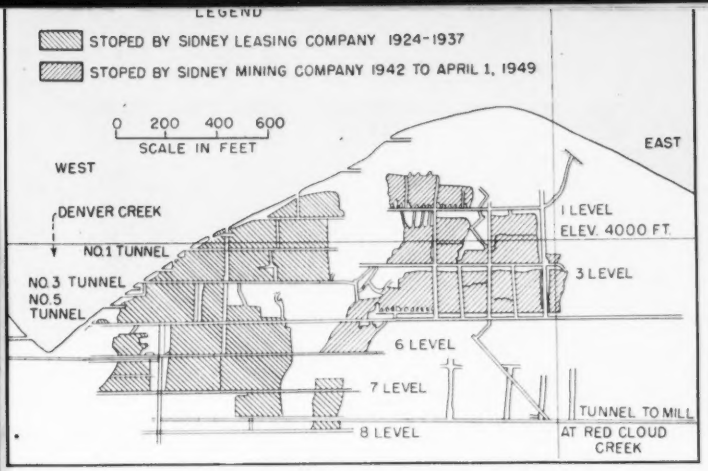
Principal minerals are galena, sphalerite, and minor amounts of tetrahedrite and chalcopyrite. The orebody lies within highly altered, bleached St. Regis quartzite approximately 2,000 ft. north of the Osburn fault. Because numerous cross fractures cause displacement of the orebody, considerable development work must still be done to determine the complete pattern. None of the levels has been fully explored for other orebodies.

While the main objective during 1948 was to mine ore to finance further shaft sinking, approximately 900 ft. of exploration and development work was also completed. Production during 1948 was maintained at 50 tons per day. During the present sinking campaign it is 25 tons per day.

E&MJ acknowledges with thanks the foregoing report by Robert D. O'Brien, mine superintendent.



LOWEST LEVEL of the mine has disclosed longest and most persistent ore shoot.



Discovery of the new eastern orebody started the Sidney on its way.

New 250-ton mill at Red Cloud Creek.

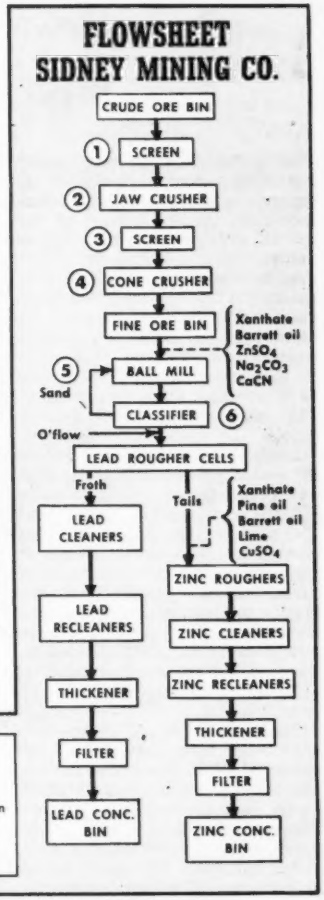
The Sidney Mine Steps Up From Small to Major Producer

PRODUCTION RECORDS best tell the story of the growth of the Sidney mine in the Pine Creek area of Idaho's Coeur d'Alene district. Following intermittent production dating back to 1910, the Sidney mine made its greatest strides since 1942 when monthly ore production was only 300 tons. At that time the mine operators were interested in the eastward extension of the old orebody shown in the above section. Bulldozer exploration on the surface by the U. S. Bureau of Mines, followed by diamond drilling, resulted in the discovery of a major orebody to the east. Production has steadily risen from about 300 tons per month in 1942 to 7,800 tons in March, 1949. Average mill feed for the first quarter of this year assayed 3.16 oz. silver, 6.1% lead, and 9.41% zinc.

Except for an initial assessment levied against stockholders in 1942 to finance the first small mill in Denver Creek, major construction and development including the Red Cloud Tunnel and the new 250-ton mill has been financed from earnings. The company has also paid substantial dividends. W. T. Simons is president of the company, and Malcolm Brown, general manager, assisted by Archie McKinley, mill superintendent.

The mine is a model modern operation, using shrinkage stoping methods and scram drifts equipped with electric slushers. Battery locomotives haul ore on the main and intermediate levels. Tungsten carbide detachable bits are used on drifters and stopers. Completion of the Red Cloud haulage tunnel last year permits gravity flow of ore, and saves the company an estimated $10,000 per month in operating costs.

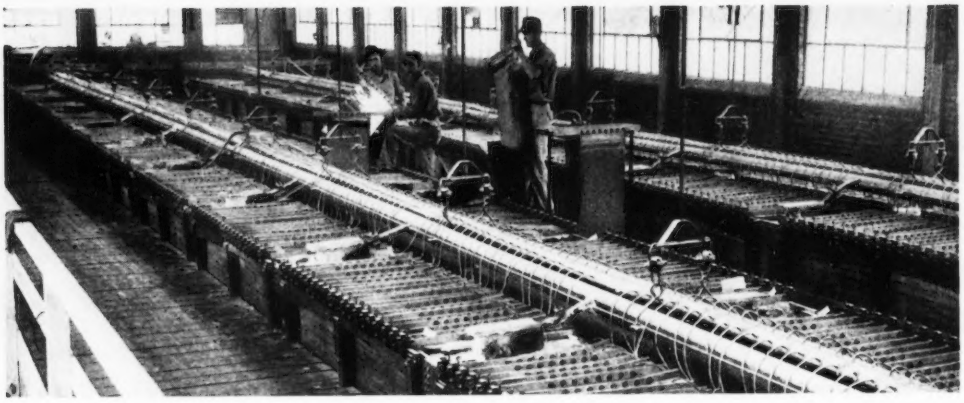
Milling was no easy problem at the Sidney because of the requirement for fine grinding to liberate values. When the new 250-ton mill was started in 1946, grinding at 90% minus 200-mesh seemed necessary. But this caused zinc sliming which interfered with clean lead recovery. Subsequently grinding has been reduced to 70% minus 200-mesh with good results. Ball mill load has been increased to the unusual high of 74% solids which has gained the Sidney the reputation of "having the quietest ball mill in the Coeur d'Alenes." Classifier overflow is carried at 44% solids.



LEGEND

1. 3-in. Vibrating Screen
2. Traylor 15 x 24-in. Jaw Crusher
3. 1¼/½ Double-Deck Vibrating Screen
4. 4-ft. Symons Shorthead Cone
5. 8x48 Hardinge-type Ball Mill
6. F-6 Dorrco Rake Classifier

High solids in the ball mill and classifier overflow solved the slime problem.



PRIVATE CAPITAL built and operates this electrolytic manganese plant at Knoxville, Tenn. Process is now reliable and controllable.

Private Enterprise Succeeds With Electrolytic Manganese

PRACTICALLY PURE MANGANESE metal, made electrolytically, is being produced today on an important scale largely because of the patient efforts of the privately organized Electro Manganese Corp. over a 10-year period. Last year the output of this company's plant at Knoxville, Tenn., reached its high point of over 4½ million pounds, bringing the total made by the company during the decade to more than 22 million pounds. The manganese is about 99.98% pure.

During this period, the trend in the company's production and sales has been one of steady, though perhaps not spectacular growth. The price of the metal has been lowered to 28c. a pound, in carload lots, from 40c. for a less pure grade. About one half of the plant's production has gone into ferrous manufacture and one-half into nonferrous alloys and into chemicals. The installed capacity of the plant is about 450,000 lb. of metal a month.

The plant at Knoxville was originally designed by Bureau of Mines' personnel after prolonged laboratory work in the Bureau. Proposed initial capacity was 2,000 lb. of manganese metal a day. Construction by the Bureau was completed in 1939. However, many unforeseen difficulties were encountered. At this point the Electro Manganese Corporation entered the picture and took the project over. Further research was necessary and its technical staff set to work upon the problems. Complete redesign and rebuilding of the plant followed.

Only Private Capital

All funds for this work and for the plant construction were furnished by private investors, who likewise made up the early operating losses. An exception was the wartime financing by Defense Plant Corporation of an addition to plant capacity. The money thus advanced has since been almost entirely repaid to the Government through rentals and interest and purchase of facilities.

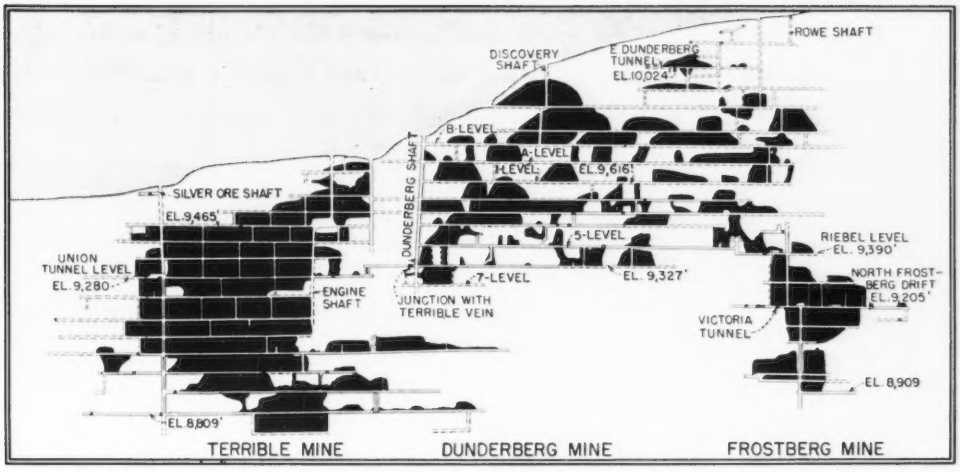
The Record Is Good

Commercial production really began in January, 1941, in the opinion of the Electro management. Some manganese nevertheless was produced in the two years preceding—over 43,000 lb. in 1939 and almost 419,000 lb. in the following year. Output then jumped to more than 1,190,000 lb. in 1941 and made a further 10% increase in 1942. Thanks to the addition to plant capacity, completed in May, 1943, the next three years saw production mount steadily, the outputs for 1944 and 1945 being between 3,300,000 and 3,400,000 lb. respectively. Production fell almost a third after the war in 1946 but just missed 3½ million lb. in 1947. Last year it reached its high point of over 4½ million, as stated previously. The electrolytic metal has had to compete with the various grades of metallic manganese long made by other methods.

In the past decade some electrolytic manganese has been made by the Bureau also. In the five years 1942-1946, inclusive, a total of approximately 1½ million pounds was produced. This was made in the Bureau's experimental plant at Boulder City, Nev. This plant embodied many features that were different from the Knoxville commercial plant. Certain items developed at Knoxville were used, just as the latter plant has been using the sulphur dioxide gas addition developed in the Bureau.

Since 1946 the Electro Manganese Corporation has been the only producer of electrolytic manganese in the United States. Technologically, the operation at Knoxville has made substantial progress. Today the company thinks its process is as reliable and controllable as other commercial electrochemical processes.

In an early issue, the full story of the Knoxville enterprise will be told by Russell H. Bennett, chairman of the Electro Manganese Corporation's board.



THREE OLD MINES, at Silver Plume, Colo., rehabilitated under one owner, show good ore in virgin ground (center and right).

New Mines From Old

WALTER E. SCOTT, JR.
Consulting Engineer
Gold Mines Consolidated, Inc.
Denver, Colo.

EARLY-DAY MINERS around Silver Plume, Colo., as well as other Western mining districts, were greatly troubled by the conflicts rising out of restricted ownership. Apex litigation was commonplace.

In Silver Plume, at least, we have been able to bring several claims together under one ownership. Beginning with this advantage, our exploration of these old mines has uncovered good ore in some of the workings and broken into a promising virgin territory.

Silver Plume, in the Front Range of the Rockies west of Denver, is one of Colorado's oldest and most productive silver mining areas. Not until 1921 did rising costs finally bring mining activity there to a halt.

Claims Consolidated

During 1943 and 1944, two mines were again operated in Silver Plume. In 1944, Harvey L. Tedrow and I investigated the area, and began to acquire properties in it. Eventually we held options, leases or purchase contracts to more than 200 mining claims, covering an area about 2,500 ft. wide by 9,000 ft. long. This included such famous old mines as the Terrible, West Terrible, Fenton, Brown, Mammoth, Dunderberg, Frostberg, Mendota and others.

In 1945, we gave an operating lease to Gold Mines Consolidated, Inc., covering these various properties. In April, 1945, the company began rehabilitation of the area by reopening the Union Tunnel of the Terrible mine. (At left in above map.) The tunnel was repaired as far as the Silver Ore shaft, which had been under water for 25 years. This work convinced the company that the Terrible-Dunderberg group was worth rehabilitating.

On Feb. 1, 1946, Gold Mines Consolidated began this job of general mine rehabilitation. From then until the first ore was mined in August, 1948, the company had to put in new timber throughout the following workings: 4,000 ft. of drifts; 450 ft. of shafts; 500 ft. of raises. About 3,000 ft. of new track, 4,000 ft. of air and water lines, and 3,000 ft. of ventilation lines were put into the mine. All this meant large expenditures before any production could come from the mine at all.

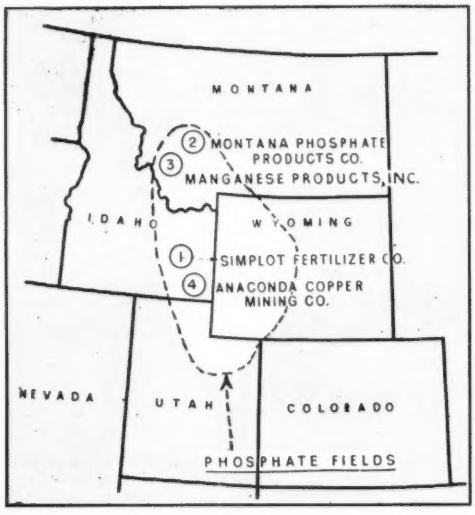
Beginning in August, 1948, however, the mine has been producing about 30 tons per day on the average of ore running 8½ oz. of silver, 4.7% lead, and 5.8% zinc. We have been able to do only a limited amount of exploration, and it was not until May, 1949, that we achieved really promising results. Just within the last two months, we have been able to get in under the old Dunderberg mine (center of map) by extending the 1,300 Terrible level to the east. We have found some ore and it looks as though it might be the downward extension of the rich surface orebody of the Dunderberg mine.

Prospects Good

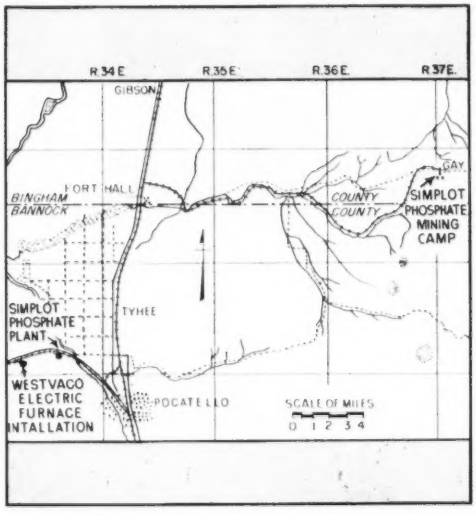
On Jan. 15, 1949, the company extended its rehabilitation work to the Frostberg workings of the Mendota mine. (Right section of map.) We have retimbered an old winze, laid new track for about 2,000 ft. in the Victoria Tunnel, and have found ore in good quantity and value in the Frostberg winze below the tunnel. Within the next two months, this section should be in production as well.

The advantages of single ownership are apparent. With the Terrible-Dunderberg group in production, and the Frostberg mine about ready to produce, Gold Mines Consolidated can begin to reopen other old mines in the same area. At the depth to which modern methods make it possible to work, we feel that new ore will be developed and the Silver Plume district will again become a consistent producer of silver and lead.

Foresight and enterprise have keynoted the advance of non-metallic mineral industries in the U. S. This is how two major industrial minerals are being produced today and developed for tomorrow



WESTERN PHOSPHATE DISTRICT accounts for almost 15% of the total production for the U. S. About 10 companies are active.



SIMPLOT FERTILIZER CO.'S mining operations are 16 miles east of Fort Hall. Close by are Simplot's and Westvaco's plants.

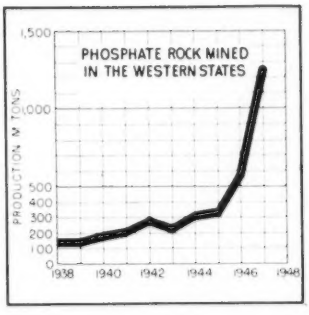
Western Phosphate Output Soars

CURRENT PLANS in the western phosphate industry indicate that the high level of production reached in its meteoric rise over the last few years will be maintained. Just how sharply the output of phosphate rock increased in Idaho, Montana, Wyoming and Utah is reflected in the accompanying graph.

General activity and interest in the area are still mounting. Here are some of the recent projects.

Westvaco Chemical Co., a subsidiary of the Food Machinery and Chemical Co., will build a second electric furnace at Pocatello, Idaho, for the reduction of elemental phosphorous from the Fort Hall shale deposit. The new furnace, costing $2 million, is in addition to the $4-million project already under way in the area. Capacity will be 30 tons of pure phosphorus a day. Completion is scheduled for early in 1950. The first Westvaco furnace has just been placed in production.

Placed in production this year is

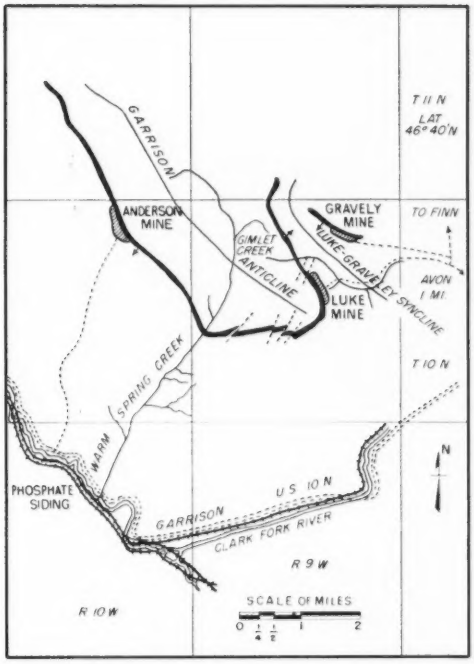


a fertilizer plant erected at Wendell, Idaho, by Gates Brothers with the financial cooperation of the Idaho Farm Bureau Federation. The plant produces "Gem State Phosphate," a treble superphosphate.

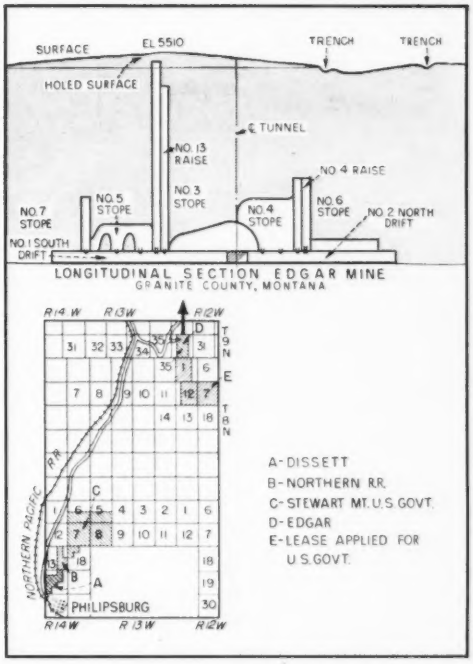
The J. R. Simplot Fertilizer Co. leased 1,124 more acres of phosphate mineral land this year from the Department of the Interior. Under terms of the lease, the Simplot company is required to invest $56,000 in actual mining operations, developments and improvements. In the deposit, low-grade phosphate rock forms the overburden covering the high grade. The University of Idaho school of mines is now developing a process to treat the heavy overburden tonnage economically.

Manganese Products Inc. has made application to the U. S. Government for 1,600 acres of phosphate mineral land adjoining their present lease in the Maxville area of Montana. Indicated ore reserves are calculated at 4,986,000 tons of rock containing 30% P_2O_5.

Following is a glimpse at the activities of four of the mining companies in the western phosphate area. Other companies whose operations are not covered in detail are San Francisco Chemical Co., George Relyea, Silica Products Co., Moonlight Mining Co., Garfield Chemical and Manufacturing Corp.,



MONTANA PHOSPHATE PRODUCTS CO. operates three mines on the Phosphoria bed. Product goes to fertilizer plant at Trail, B. C.



MANGANESE PRODUCTS, INC., has leases in two areas in Montana. Width of mineable ore in Edgar mine averages 4 ft.

and Phosphate Mines Inc., all of which are also active in the West.

Simplot Fertilizer Co.

Surface mining operations of the Simplot Fertilizer Co. are located near Fort Hall, Idaho. Stripping operations were begun there in June, 1946. Total production to date has been 786,000 tons of phosphate rock. To uncover this ore, it was necessary to remove 900,000 yd. of topsoil, 155,000 yd. limestone cap rock, and 1,800,000 yd. shales. Stripping ratio of ore to waste is about 1:5.

The stratigraphy of the Fort Hall phosphate beds is very similar to that found throughout southeastern Idaho. General pattern and sequence of the lower 60 to 65 ft. of the Phosphoria shale member, as exposed by diamond drilling, stripping and mining operations, is as follows: Six feet of oolitic phosphate rock, locally known as the "main bed," lying immediately above the Wells formation; 2 to 4 ft. of limestone, locally known as "cap rock"; a fairly constant 25-ft. thickness of phosphatic shales, and another 2 to 4 ft. of limestone, which has been termed "false cap rock." Immediately overlying the false cap rock is a series of alternating phosphatic shales and limestone beds and lenses about 35 ft. thick. These are followed by a series of siltstones.

Experimenting with various methods of stripping has resulted in assigning one particular piece of equipment to each particular job. Bulldozers and scrapers remove topsoil. Phosphate shales are removed by 2½-yd. shovels and trucks. High-grade rock is mined with smaller shovels.

Prior to mining, panels are staked out on the ground as indicated by geological data. Panel size is controlled by fault blocks, depth of overburden, and the location of spoils areas.

Sampling and mining the phosphatic shale beds have shown that they have considerable variation in P_2O_5 content throughout the geological column. However, several thicknesses are suitable for electric furnace feed. As a result, all phosphatic shale members overlying the main bed are mined selectively.

Although practically all of the equipment now in operation at the mine is the most suitable for selective mining of the lower phosphatic beds and the requirement for flexibility, future mining will entail greater depths of overburden. A large proportion of this future overburden will not be amenable to selective strip mining but will be removed as units up to 75 ft. deep. These large yardages of waste material low in P_2O_5 content necessitate overburden removal at low cost. Comparison studies are now being made on the larger types of earth-moving equipment.

Processing Phosphate Rock

Equally as important and interesting is the processing plant at Pocatello, where the rock is treated with sulphuric acid so that the P_2O_5 in the rock is made available as a plant food. Originally constructed in 1944, continued expansion has increased production facilities so that the plant is numbered among the largest in the nation. Mined rock brought to the plant in 75-ton gondola cars is stockpiled, with daily plant requirements being bulldozed into a pit, whence the rock is belt-conveyed to a hammer mill. Re-

FERTILIZER PLANT at Anaconda produces treble superphosphate and phosphoric acid as well as mixed fertilizers. Ore is hauled from Anaconda Copper Mining Co.'s phosphate property at Conda in southeastern Idaho. Plant capacity is being increased.

duction of the mill product to fine powder is done in Raymond pulverizers. The next step in the treatment process is combining the dust with sulphuric acid. Known as the acidulation process, the combination of the two materials takes place in what is known as a "den," a box car affair on wheels. Combining of the rock with sulphuric acid causes a chemical reaction which makes the phosphoric acid in the rock available for plant food. After the combined materials have "cooked" in the den, the product is cut out by whirling knives and elevated up and over to a curing pile where it must remain for more than three weeks. During the curing period a further combination of the rock and sulphuric acid takes place until the neutralizing reaction of the acid is completed. Following the curing period the material is carried by underground conveyor to the bagging operations.

E&MJ wishes to convey its gratitude to Heath B. Fowler, chief engineer, general exploration, of Simplot Fertilizer Co., for this report of the company's operations.

Anaconda Copper Mining Co.

Problems of marketing phosphates as well as mining it have faced Anaconda Copper Mining Co. since it first began experimental work in the production of high-analysis superphosphates in 1915. The company's mining operations are centered at Conda, Idaho, but the phosphate rock is shipped to Anaconda, Mont., for processing.

At the time the Anaconda plant began commercial operation, a product containing 45 to 48% P_2O_5 was turned out, as compared with 16% P_2O_5 in the regular superphosphates. For this reason the product was named "treble superphosphate."

Practically no market for the product existed in the Mountain or Pacific states because of the relatively virgin soil. Outlets were established in Indiana, Michigan, Ohio and Kentucky. Thousands of tests and demonstrations were needed to overcome the farmers' belief that high-analysis superphosphates were so concentrated they would burn the crops and ruin the soil. It had to be shown that Anaconda's new product not only was non-injurious, but that it contained three times the fertilizing value of low-grade superphosphates. The saving of time and labor by spreading one ton of fertilizer instead of three was soon recognized by the farmer.

In addition to treble superphosphate, various mixed fertilizers and phosphoric acid are produced in the Anaconda plant. The company has been one of the pioneers in the field of liquid fertilizers and the technique of using liquid phosphoric acid in irrigation waters. Liquid phosphoric acid is a quick acting plant food, is convenient and economical to apply, and on certain soils it gives better results than dry material.

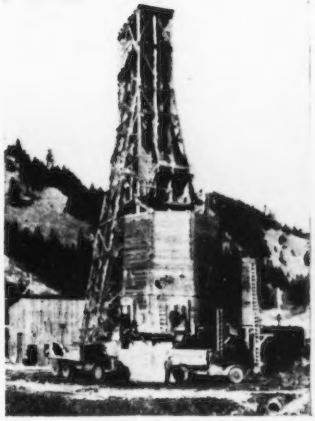
The original superphosphate plant of the Anaconda Copper Mining Co. was expanded to the point where it was producing at twice its rated capacity. A new sulphuric acid plant was then needed to produce any more phosphate. Construction of the new acid plant, along with expansion of the superphosphate plant facilities, now nears completion. The addition will almost double Anaconda's capacity for production of treble superphosphate and phosphoric acid.

For the above information on Anaconda Copper Mining Co.'s phosphate interests, E&MJ is indebted to F. O. Case, vice president, and R. A. Jones, sales manager, fertilizer dept.

Montana Phosphate Products Company

Raw phosphate rock for Consolidated Mining and Smelting Co.'s large fertilizer plant at Trail, B. C., Canada, is furnished by its subsidiary, the Montana Phosphate Products Co., operating three underground phosphate mines near Garrison, Powell County, Montana. These are the Anderson, Graveley, and Luke mines, and production of all three is from the same phosphate bed, a 2½ to 5-ft. member of the Phosphoria formation.

The Anderson, Luke, and Graveley mines are developed by tunnels, vertical shafts, and winzes, and stoping methods vary according to the size and dip of the bed worked. The dip in the Anderson mine is 25 to 30 deg., and exploitation is by room-and-pillar method, with broken phosphate rock being scraped to loading points. Stopes are 60 ft. wide and pillars between each stope 12 ft. Drifts and crosscuts are 8x8 ft. in cross-section. Mine production is hoisted to the surface through a three-compartment vertical shaft 475 ft. deep.



BOTH UNDERGROUND AND OPEN-PIT methods are used to mine the Phosphoria bed in western phosphate area. At left is the headframe of Montana Phosphate's Anderson mine. At right a power shovel loads diesel trucks at Simplot's Fort Hall deposit in Idaho.

The two hoisting compartments and manyway measure 4½x5 ft. Broken rock is hauled from the stopes to the shaft pockets, or in the case of levels developed by tunnels directly to surface storage and loading bins, in 33-cu.ft. Coeur d'Alene type side-dump cars. Trains of ten cars are hauled by battery locomotives.

The phosphate bed at the Luke mine some 6 miles northeast of the Anderson is about 3 ft. wide and dips 45 deg. Development is by tunnels driven in the footwall quartzite. The bed under exploitation is badly broken by cross faults with offsets ranging from 3 to 20 ft. As the Anderson mine phosphate rock is mined in open stopes, the area between adjacent faults constitutes a single stope. No pillars are required in the stopes and normally no stulls are needed for support as the stopes are relatively narrow and separated from each other by ground left along the faults.

The Graveley mine is about 2 miles northeast of the Luke on the opposite side of the Luke-Graveley syncline. Bed widths vary from 3 to 4 ft. The upper part of the Graveley bed has a dip varying from 65 deg. to vertical, while the dip of the beds in the lower levels varies from 65 deg. in the southeast to less than 45 deg. in the northwest. Mine development consists of several tunnels at different elevations and a 550-ft. winze equipped with a 1-ton skip. Phosphate rock is mined by both open stope and a shrinkage stoping system modified to fit local conditions, with open stoping gradually replacing the shrinkage system. As in the Anderson and Luke mines, drilling in stopes is done with light stopers, broken rock scraped to loading points, and hauled to surface storage bins in ten-car trains.

Manganese Products Inc.

Phosphate mining operations of Manganese Products Inc. in Montana center around Maxville and Phillipsburg. The company produces MP Brand Phosphate at a plant in Seattle.

In the Maxville area Manganese Products has the Edgar mine under lease. It comprises 320 acres with an indicated ore reserve of 974,000 tons containing 30% P_2O_5. Application has been made to the U. S. Government for 1,600 more acres of contiguous land. Indicated ore reserves in this area have been calculated at 4,986,000 tons containing 30% P_2O_5.

At the Edgar mine, the phosphate bed strikes N 10° E and dips west at angles approximating 75 deg. The width of mineable ore is nearly constant and averages 4 ft. At the face of the north drift, a faulted condition has crushed and pinched the ore. On the surface the deposit has been exposed by trenches and an incline for 500 ft. Average height above the drift level is 130 ft.

Development includes a 300-ft. crosscut to the phosphate bed with drifts north and south totaling 270 ft. A 140-ft. raise and two 90-ft. stope raises have been driven.

In the Phillipsburg area, company leases cover a contiguous area of 2,615 acres. Indicated ore reserves are calculated at 1,300,000 tons of rock containing about 25% P_2O_5.

The phosphate bed opened at the Dissett mine is at the bottom of a syncline. It lies flat at the center but increases in dip to about 20 deg. on the limbs of the syncline. The syncline plunges 20 deg. north.

The main working tunnel is driven below the orebody and parallel to the axis of the syncline. Raises through the phosphate bed show it to be 15 ft. thick. A one-ft. thickness at the bottom contains 29% P_2O_5 and a top bed 3 to 3.5 ft. thick analyzes 30% P_2O_5. The intervening shale contains 18-20% P_2O_5.

At present, Manganese Products manufactures primarily a fused calcium-magnesium-phosphate fertilizer by an electric furnace process. Phosphate rock and olivine are the required raw materials. The olivine is obtained from a quarry in Washington.

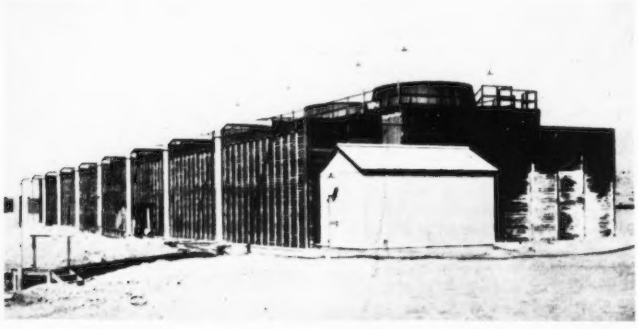
The phosphate rock is shipped to the plant at Seattle by rail, the olivine by barge. Both are dried and mixed in proper proportions before going into the electric furnace. The mix is melted at 1,500 deg. C. During this operation the phosphate structure is broken down and converted into a "plant available" form. When the melt is tapped, it is hit by a number of high-velocity water sprays into a quenching tank. This breaks the product to a minus-10-mesh size. It is then dried, ground and sacked.

E&MJ acknowledges its appreciation to Norman Ketzlach, chief chemist of Manganese Products Inc., for the above details on the company's operations.

SURFACE PLANT of International Minerals and Chemical Corp. produces K_2SO_4 and chemical grade KCl in a parallel operation.

Carlsbad Potash Industry Expands

NEW DIESEL LOCOMOTIVE hauls U. S. Potash Co. ore to refinery.



WATER COOLING TOWER handles 30,000 gpm. for USP plant use.

JACK PIERCE
Secretary-Treasurer
New Mexico Miners and Prospectors Assn., Albuquerque, N. M.

WITH THEIR RECENT and impending improvements, the three companies producing potash in the Carlsbad area of New Mexico expect to top their 1948 production record of five million tons this year. Supplying 85% of the potash used in the U.S., the area is of tremendous importance to agriculture which takes 92% of the output in commercial fertilizers and soil stimulants. About 8% is consumed by industry as potassium chemicals.

The three companies, United States Potash Co., International Minerals and Chemical Corp., and Potash Company of America commenced operations as a new industry early in the 1930's. Annual production figures of 835,000 tons for 1937-1939 and a 2,500,000-ton average from 1940 to 1944, indicate how they have expanded to keep pace with the rising demand.

Certain contemplated modifications in practice are general throughout the Carlsbad area. They are watching with interest, the development of universal min-

$4-MILLION PLANT EXPANSION program begun in 1948 by Potash Company of America will raise output of refined products 50%.

ing machines and the possible applications to potash mining. Experimental work is under way with the Joy hydraulic jumbo drill, with drilling rates up to 10 ft. per min. recorded. Two-drill tractor and rubber-tired units may be tried. Experimentation with explosives and drill holes continues. Results indicate a possible trend toward smaller drill holes and thinner sticks of powder to get greater lineal distribution and improved fragmentation.

Here are some of the companies' individual projects.

United States Potash Co. produces high-grade potassium chloride from a sylvite ore. Currently, preparations are being made to start construction of a $1-million refinery addition to increase the output of chemical grades by 25%.

Underground, USP is investigating the use of Joy mobile type loading machines, designed for work in hard rock. They are also trying out "bug dusters" on undercutters, to get a cleaner kerf for blasting. In refining they have worked out a continuous flow solution process.

A decrease in operating costs on the 16-mile tramroad between mine and refinery was secured when a new 70-ton diesel locomotive and several new ore cars were placed in service last year. Three steam locomotives are used on the line.

A $500,000 nine-section, forced draft cooling tower was erected for cooling water used in crystallization equipment and steam turbine condensers. About 30,000 gpm. are handled in the closed circuit system. The availability of ample cold water improves hot-weather operating conditions, and careful chemical control reduces scaling in the condenser tubes.

Revision was made to the brine circuit in the granular pit by the addition of a thickener, 6 ft. deep and 75 ft. in diameter. The unit was built with a sloping tank bottom. Steel wall plates were set in a groove around the perimeter, and sealed with Horn expansion joint cement mixed with jute fiber.

Potash Company of America launched a $4-million expansion program in 1948 to increase its output of refined products by 50%.

Largest single expenditure was for a 26-mile, 12-in. pipe line to replace the old 6-in. line carrying fresh water from the city of Carlsbad to the plant. The new gravity line eliminates the need for pressure pumps.

A new 1,000-hp. automatic hoist, installed in No. 1 shaft, is the largest in the district. Hoisting capacity has been increased 65%.

Two 6x14-ft. Marcy low discharge rod mills were placed in the wet grinding section of the mill. A new thickener, 10 ft. deep and 75 ft. in diameter, made of steel, lined with gunite, has brought about a 33% increase in thickening capacity. Three new driers, 8 ft. in diameter and 53 ft. long, carry a load which required at least seven of the old type.

Other improvements include a new No. 3 shaft, a Symons cone crusher, six new cooling agitator plants, a new 24-cell flotation section and a new large tank for acid storage.

The present trend in PCA's refining practice is the replacement of continuous centrifuges with filters.

International Minerals and Chemical Corp. placed its $1,500,000 remodeled sulphate section in service last February. The unit will produce agricultural grade potassium sulphate and chemical grade potassium chloride in a parallel operation.

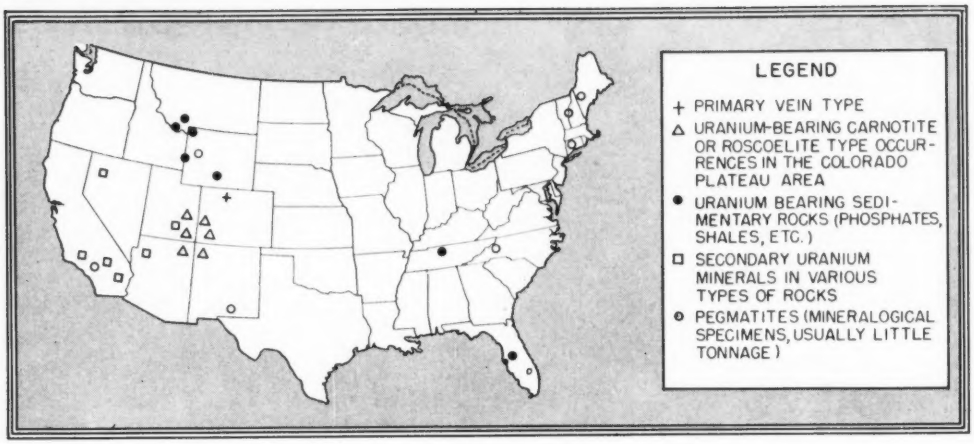
In the mine, a third operating level has been completed. The new level, at 850 ft., is a source of langbeinite ore, and this company is the only one mining such ore.

Presently under consideration is a belt gathering conveyor in panel entries with possibly a portable crusher at the head of the belt to be fed by shuttle cars serving the panel rooms. Additional lengths of conveyor may be added as the panels advance.

A new manway, ventilation shaft and surface plant are planned for development of ore reserves southwest of current operations.

In refining, the trend is toward the replacement of filters by continuous centrifuges.

Where uranium ore is found . . .


LEGEND
+ PRIMARY VEIN TYPE
△ URANIUM-BEARING CARNOTITE OR ROSCOELITE TYPE OCCURRENCES IN THE COLORADO PLATEAU AREA
● URANIUM BEARING SEDIMENTARY ROCKS (PHOSPHATES, SHALES, ETC.)
□ SECONDARY URANIUM MINERALS IN VARIOUS TYPES OF ROCKS
⊙ PEGMATITES (MINERALOGICAL SPECIMENS, USUALLY LITTLE TONNAGE)

Uranium—A Job for Mining Men

"The program of the U.S. Atomic Energy Commission is firmly based on the assumption that new uranium mines can best be found, developed and worked by individuals and private companies seeking profits."—*J. K. GUSTAFSON, Mgr., Raw Materials Op., AEC.*

IN ITS EFFORT to free the United States from dependence on foreign sources of uranium, the Atomic Energy Commission has placed the burden squarely on the shoulders of private enterprise. The American people as a whole have responded with enthusiasm. The mining industry has contributed, but it can, and must, do a lot more. For, after all, finding and mining uranium is like any other business; it can be done best by professionals with technical know-how and experience.

"How pressed is the United States for uranium?" may well be answered by another question. How many minerals are being mined today to sell for a minimum price of $3.50 per lb., guaranteed for 10 years?

What We Have Now

At present, the Colorado Plateau area is the chief source of domestic uranium ore in the form of carnotite. For reason of national security, production figures are unavailable. Leading producers are U. S. Vanadium Corp. and Vanadium Corporation of America. Much ore is mined in the area, however, by small independents using almost primitive methods. In addition to their mining operations, USV has mills at Rifle and Uravan, and VCA runs plants at Durango and Naturita. A mill built and operated by VCA at Monticello during the war has recently been taken over by the Atomic Energy Commission. These mills all buy ore on the same price basis.

What Mines Can Do

Many metal mines overlook the possibility that the rock they have been mining for years may contain appreciable quantities of uranium. This is not only poor business, but a neglect of patriotic duty.

Here are some easy and inexpensive steps mine and mill men can take to be sure no possible source of the all-important radioactive element is passed up.

1. Carefully go over tailings piles with a Geiger counter. This procedure led to the discovery of

URANIUM OXIDE CONCENTRATE is produced by this U. S. Vanadium Corp. mill at Rifle. Five such mills in the Colorado Plateau area buy ore on the AEC price basis.

Where to send your samples . . .

If you think you've found uranium . . .

Rock and mineral samples may be tested for radioactivity, without charge, at the following agencies. One-lb. samples, honestly representative of the deposit, should be selected. Wrap securely and label clearly. Results are sent only to the person submitting the sample.

U.S. Geological Survey
Geochemistry and Petrology
Branch Bldg. 213, Naval Gun
Factory, Washington, D.C.

Chief, College Park Branch
Metallurgical Division
U.S. Bureau of Mines
College Park, Maryland

Chief, Rolla Branch
Metallurgical Division
U.S. Bureau of Mines
Rolla, Missouri

Chief, Salt Lake City Branch
Metallurgical Division
U.S. Bureau of Mines
Salt Lake City, Utah

Division of Natural Resources
Department of Agriculture,
County of San Diego
4085 Rosecrans Street
San Diego 10, California

Idaho Bureau of Mines and
Geology
Moscow, Idaho

Chief, Albany Branch
Metallurgical Division
U.S. Bureau of Mines
Albany, Oregon

Chief, Tuscaloosa Branch
Metallurgical Division
U.S. Bureau of Mines
Tuscaloosa, Alabama

Chief, Tucson Branch
Metallurgical Division
U.S. Bureau of Mines
Tucson, Arizona

Supervising Engineer
Metallurgical Division
U.S. Bureau of Mines
Reno, Nevada

Nevada State Analytical
Laboratory
University of Nevada
Reno, Nevada
Note: This agency will test samples from the State of Nevada only.

Montana Bureau of Mines and
Geology
Butte, Montana

What the AEC pays . . .

Domestic Uranium Program

1. Minimum price guaranteed for 10 years is $3.50 per lb. of U_3O_8 (uranium oxide) contained in the ore, less milling costs. (This is not good for Colorado Plateau area.)

2. $10,000 bonus is payable after delivery of the first 20 tons of ore or mechanical concentrates containing at least 20% U_3O_8, from a single, previously unworked claim. This is in addition to payment for the ore.

3. Provisions are made for adjusting shipping costs and for purchasing associated minerals.

pitchblende, a primary ore of uranium, at the Caribou mine in Colorado.

2. Arrange to take a Geiger count of all ore at some point between the face and the mill. A Geiger counter located at the portal, for instance, would furnish a systematic check with little effort. A large metal mine in the U. S. which recently began a similar check may soon be producing uranium.

3. Check sludge and cores from all drilling operations for radioactivity. Even examination of old cores may lead to something previously overlooked. This is important when you consider that even a high-grade radio-active mineral under as little as two feet of overburden, can rarely be detected by a Geiger counter on the surface.

4. Custom mills, through which ore from a wide area funnels, would be strategic locations for Geiger counters.

The whole problem of concentrating carnotite requires further study. Despite much effort under AEC direction, no satisfactory solution has been worked out. A practical and economical method would benefit the nation and be very profitable to the patent holder.

Experienced mining men and modern equipment could effect an immediate improvement in many of the present small scale operations in the Colorado Plateau area. Other mines where ore is pinching off might do well to invest technical knowledge and equipment in uranium's future.

FOUR FT. OF URANIUM ORE appears as dark band behind wheelbarrows. This is the portal of a Vanadium Corporation of America mine on the Navajo Indian reservation.

No Red Tape

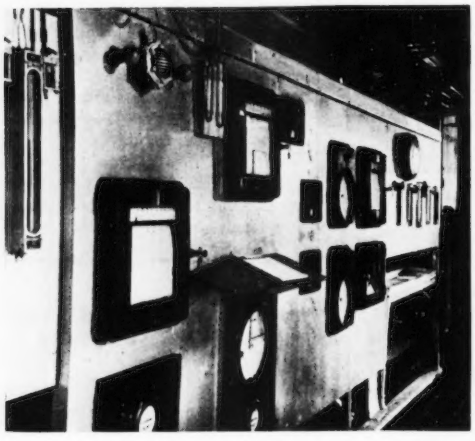
Some mining men engaged in mining another mineral at properties where conditions are favorable for the occurrence of uranium, are misguidedly discouraging further investigation. They feel that if they start mining uranium they will soon become tangled up in Government red-tape. This is a completely false notion. Actually, uranium is easier to sell to the Government than gold. All that is required is getting an AEC license to remove the ore from the place at which it is mined.

All benefits of the Government's domestic uranium program (above) hold for companies who are already mining other minerals on their property as well as for prospectors.

In a campaign to establish U. S. uranium production, the prospector plays an important role. At present an average of 300 samples per month are being checked by the USGS. This represents a tremendous number of searchers, many of them amateurs. The professional, knowing where and how to look, is the more reliable agent.

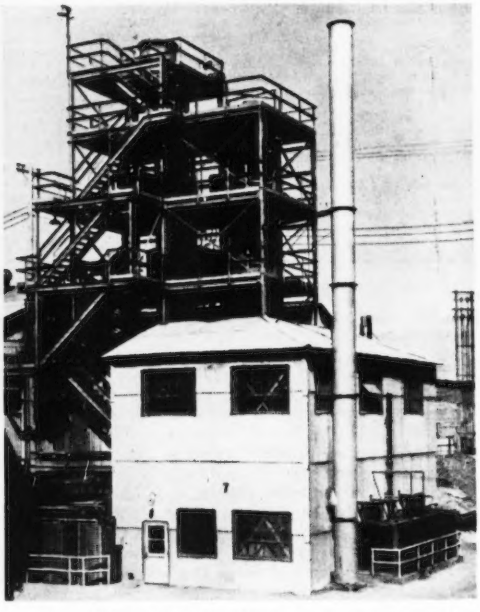
Just published by the AEC and USGS is a handbook entitled "Prospecting for Uranium." This handy reference covers the classification of uranium minerals, the various types of deposits (see map above), how to operate, maintain and run a survey with a Geiger counter, laboratory assays and selling procedures, and the regulations involved. The book is on sale by the U. S. Government Printing Office, Washington 25, D. C. Price is 30c.

Metallurgical plants will match future mine production with increased smelting capacity and more efficient processes to recover metals and by-products now going to waste in stack gases and slag



WELL EQUIPPED INSTRUMENT PANEL facilitates control of the liquid SO_2 process in ASARCO's plant at Selby, California.

Development of Liquid SO_2 Plant Climaxes 30 Years of Research by ASARCO in extracting Commercial Byproducts from Waste Gases



LIQUID SULPHUR DIOXIDE PLANT began operating late in 1947. It now produces 20 tons per day on a commercial basis.

Selby Plant Makes Liquid SO_2 From Waste Smelter Gases

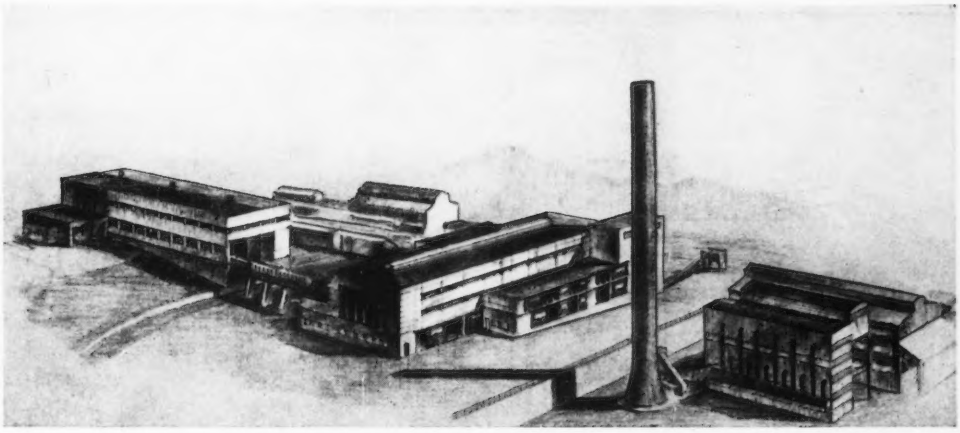
BY USING WASTE SMELTER GASES to manufacture a useful chemical, American Smelting and Refining Co.'s liquid sulphur dioxide plant not only provides a marketable smelter byproduct, but eliminates smoke nuisance in the area around the plant as well.

Now considered as operating on a commercial basis, the 20-ton plant commenced operation at Selby, Calif., late in 1947 as the result of the company's research program. For 30 years ASARCO has been investigating various possibilities for production of liquid SO_2 as a part of a long range program of finding commercial outlets for byproduct smelter gases.

Previous processes, largely developed in Europe, for recovery of SO_2 through absorption by chemicals involved a loss of reagent due to high vapor pressures. In the ASARCO process, patented by E. P. Fleming and Dr. T. C. Fitt and assigned to the company, dimethylaniline is used as an absorbent for the SO_2. According to Mr. Fleming, approximately 15% SO_2 by weight can be absorbed by this chemical in an eight-tray column with the amazing efficiency of 99%. The finished SO_2 product, after passing through the plant, is of low moisture content. It is compressed, liquefied and shipped in pressure tank cars to the consumer.

Farmers Use SO_2

The liquid sulphur dioxide plant was designed for a technical grade SO_2, but has been able to turn out a high quality refrigeration grade. This is purchased in its entirety by the Dow Chemical Co. for delivery in tank cars, f.o.b. Selby. Principal users of the product are oil and sugar refineries. In addition to these users, however, liquid SO_2 is being used to fumigate alkaline soil. The farmer buys the SO_2 in cylinders and bleeds it into the irrigation water. Use of liquid SO_2 in this manner is reported to have doubled and even tripled returns from farm crops.



MATERIALS HANDLING by modern methods is keynote in Consolidated Mining & Smelting Co. of Canada's new $12,000,000 lead smelter under construction at Trail, B. C. From left, artist's drawing shows bedding and storage, sintering plant, and blast furnaces.

Cominco's Streamlined Smelter

BEGINNING WITH THE FIRST lead ore smelted at Trail, B. C., near the turn of the century, growth of the lead smelting facilities was guided by the need for not interfering with the copper plant. Material flow through the present lead plant is therefore far from ideal, and in certain respects definitely awkward.

Room For Improvement

The company recognized long ago that modernization of the lead smelter, making use of recent advances in materials-handling equipment, for example, would yield substantial operating economies. Plant hygiene would also benefit. Because Cominco has enough ore in the Sullivan mine to insure many years' operation, it appeared that the large investment required for such modernization could now be safely undertaken.

Before starting preliminary design, the smelter staff made a thorough review of smelting practice all over the world. Models of various layouts were set up, criticized, revised or rebuilt until a final model was built that seemed to combine all desirable features. However, as detailing progressed, any variations in detail were again modeled before approval.

About 80% of the Trail smelter feed is fine flotation concentrate or byproduct, high-moisture, precipitated slime from other Cominco operations. In 1932 tests had shown that these charge ingredients could be mixed in a slurry and then nodulized as feed for the sintering machines. Large-scale tests had to wait until the new plant was planned. In the new smelter, this slurry-mixing method will be used, and this is about the only radical departure from orthodox lead smelter practice in the new plant.

The new smelter will be built on the site of the present plant because it is near a two-furnace slag fuming plant of relatively modern design, and because supply and disposal services are readily available. Also, it was possible thus to provide gravity flow of slag from the blast furnaces through the holding furnaces to the slag fuming furnaces. This eliminates the expense of ladle transfer. The new plant construction will go on with practically no interference with existing operations. It will take about five years to finish the new plant.

Under the straightforward new flow plan, incoming ores and concentrates will be received by truck or standard-gage railway car in a building housing primary sinter feed bins as well as live storage bins. Transfer from open cars to feed bins will be by clamshell direct. Material from closed or hopper cars will pass through transfer bins.

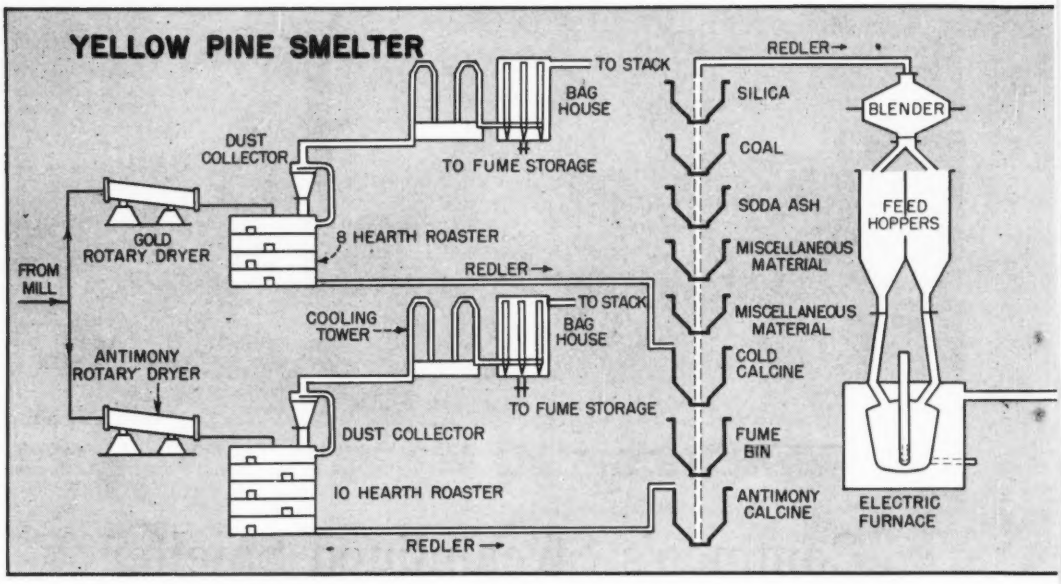
Sinter feed materials will be belt-weighed out of these bins in proper proportion and will meet the byproduct wet slimes at the head ends of three rotary kilns. Proportion of wet slimes is controlled through displacement pumps.

The mixed feed leaves the rotary kilns in the form of nodules, the size of which can be controlled, and is fed onto a 10x60-ft. moving-pallet sintering machine. Primary sinter is crushed to about 10 mesh, mixed with certain secondary sinter feed ingredients, then mixed in a barrel mixer and fed to a secondary sinter machine of the same size. A third sintering machine is held in reserve as a spare.

Two Furnaces Planned

Final sinter travels on a steel belt to the furnace feed floor, where it meets coke in predetermined proportions to make the furnace charge. Long-range plans, not included in the present program, call for two smelting furnaces of undetermined type, as well as a drossing plant. The latter will cast 10-ton lead buttons for treatment in the Betts electrolytic lead refinery.

In the new smelter, dust will be collected completely from all ventilating gases. Building interiors are designed to provide minimum opportunity for dust to lodge on ledges. As the architect's rendering shows, Cominco's new smelter is designed for eye appeal as well as technical excellence.



BRADLEY MINING CO.'S $1,500,000 smelter has ingenious arrangement for proportioning materials to charge furnace.

New Smelter to Produce

CONSTRUCTION is rapidly nearing completion on the new $1,500,000 antimony smelter being built by the Bradley Mining Co. at the Yellow Pine mine. The company's decision to locate the smelter at their mine near Stibnite, Idaho, was influenced by the heavy transportation charges on concentrates. They expect to have the plant in operation by the first of August.

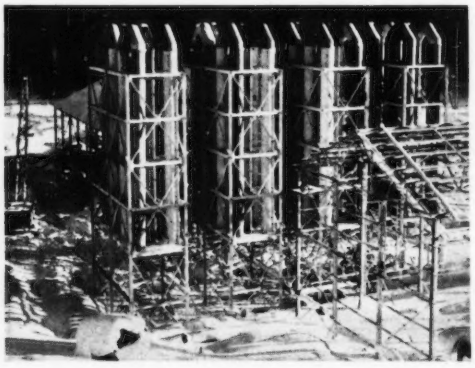
Idaho now produces more than 96% of the nation's antimony. Most of this output will be treated at the Bradley smelter, which will produce metal and oxide and high grade gold-silver residues.

Two concentrates recovered by flotation in the mill will supply the feed for the new smelter. One concentrate is high in antimony and the other high in gold.

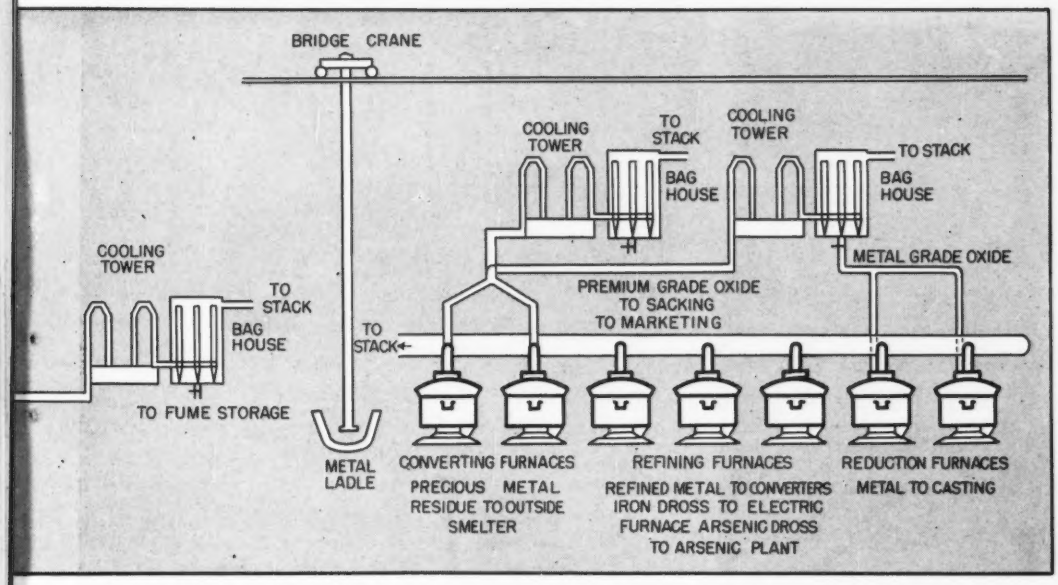
After drying, each concentrate goes to its respective roaster. The gold and antimony calcine and antimony fume are combined and fluxed to form the charge for the electric reduction furnace. Fume from the gold roaster goes to the arsenic plant.

The electric furnace produces a crude antimony bullion containing gold and silver, and a slag which

25-TON ORE TRUCKS from open pit wait to dump in mill bin.



COOLING TOWERS have 38-in. dia., rise 75 ft. from the ground.



SEVEN SMALL FURNACES will enable the Yellow Pine smelter to supply a demand that varies between antimony oxide and metal.

Most of U. S. Antimony

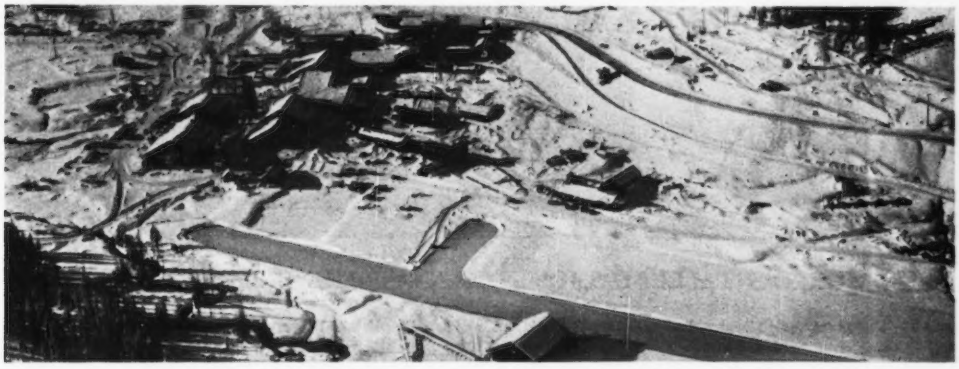
goes to waste. The crude metal is refined by removing arsenic and iron in two small oil-fired furnaces. The refined antimony metal is then converted to oxide in two butane-fired converters. The gold and silver are recovered in a rich residue from this operation.

Oxide from the converter can be bagged and sold that way or it can be reduced back to premium metal in the two oil-fired reduction furnaces. This gives the plant desired flexibility to meet changing markets for antimony and oxide products.

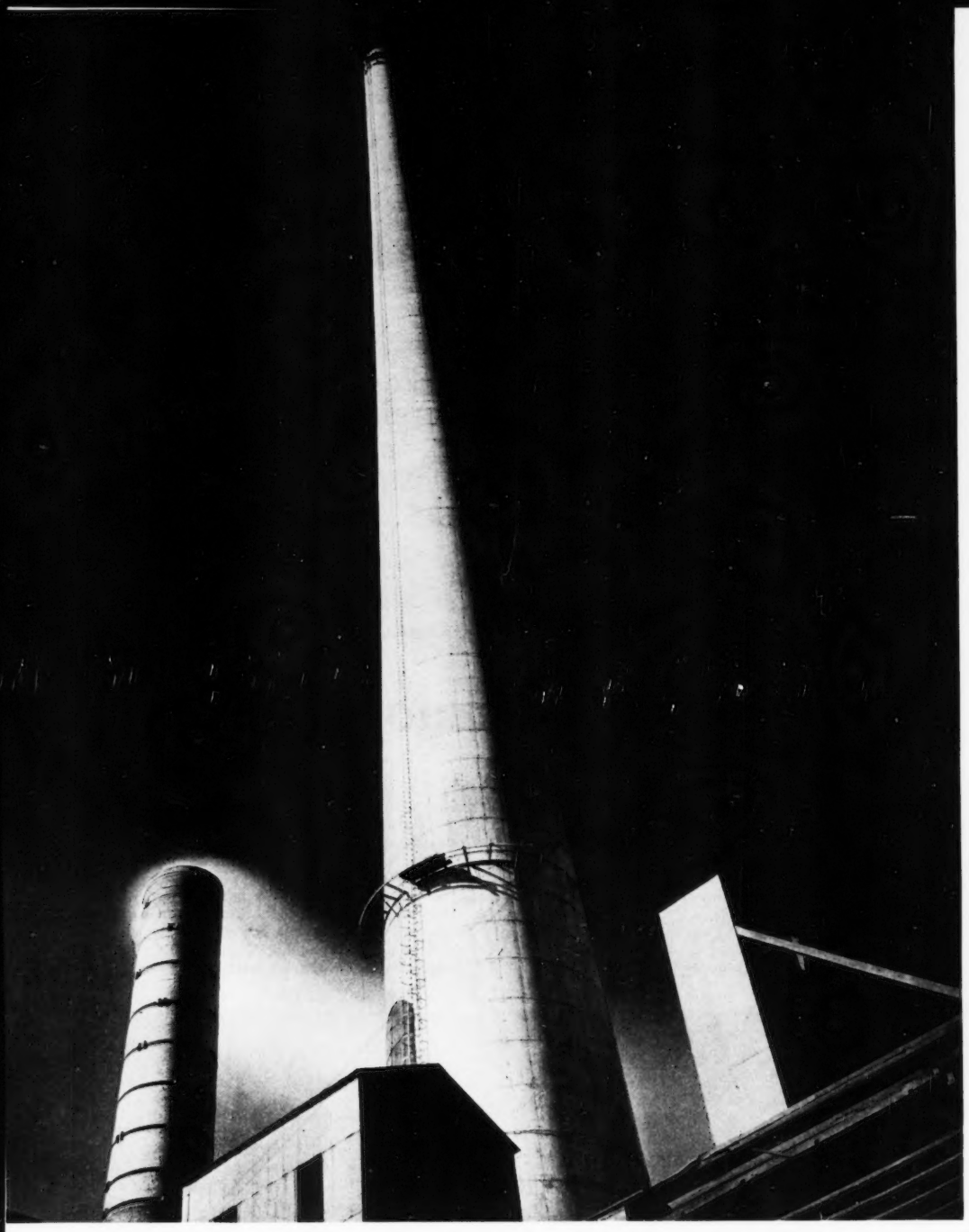
Yellow Pine is an open-pit mine with the ore occurring in a shear zone in granite. Ore minerals are stibnite, pyrite and arsenopyrite.

Primary and secondary crushers are located at one end of the pit. A conveyor belt, 1,000 ft. long, carries the ore up to the truck bins, high on the rim of the pit. Belly dump trucks, each with a capacity of 25 tons, deliver the ore to the mill bins 2½ miles up the canyon against a 3% grade.

Since the mine is 87 miles from a rail point, transportation of personnel is largely done by air. For this purpose, a landing strip has been built near the plant.



SMALL AIRPORT is for planes which link Bradley smelter, in the Primitive Area of Idaho, with other communities.



WORLD'S TALLEST SMOKESTACK AT THE SELBY PLANT*

IN ADDITION to the liquid SO_2 plant (see page 138) at ASARCO'S Selby smelter north of San Francisco, Calif., this operation has installed a new 63-in. D&L sintering machine equipped with gas recirculating facilities, and a new sinter crushing plant. Since the start of World War II, the plant has been modernized with numerous materials-handling units (E&MJ, Dec., 1948). Ores and concentrates arrive at this lead smelter and refinery from foreign sources and mines on the Pacific Coast of U.S.A. *605 ft.

HAYDEN SMELTER, in Arizona, has added new equipment to take care of increased copper production near Hayden. (See p. 92.)

GARFIELD SMELTER, Utah, has added a new anode casting plant to supply anodes to the new Kennecott refinery. (See p. 97.)

ASARCO'S Western Smelters

IMPROVEMENT AND EXPANSION of smelting and refining facilities of the American Smelting & Refining Co. parallels the increase in ore and concentrate production in areas served by the various smelters.

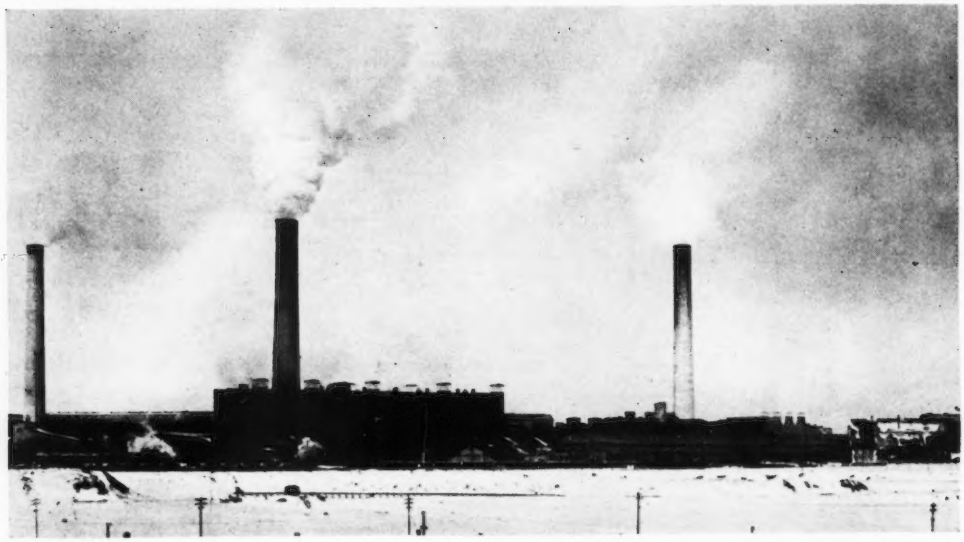
Thus, in the Hayden area where the Ray mine is increasing ore production we find that the Hayden smelter has installed a new 13x30-ft. Peirce-Smith converter, and a new 30,000-cfm. turbo-blower for increased converter requirements. Low-pressure waste-heat boilers will be converted to high-pressure units at 400 psi. A new 4,000-kw. turbo-generator has also been installed to supply additional power needs.

At Garfield, Utah, a new anode-casting plant will supply the new Kennecott refinery with anodes. Other installations include a new 250-ton acid plant and a new converter, Cottrell and flue system.

In addition to expanding plant capacity, ASARCO's operations are increasing the recovery of useful products from waste products. For instance, the Selby plant now makes liquid SO_2 from stack gases, and the Garfield and Tacoma plants will make sulphuric acid from a similar source.

TACOMA COPPER SMELTER AND REFINERY

ORE-HANDLING facilities at the Tacoma, Wash., plant have been improved by the recent installation of two new 100-ton-per-hour crushing mills and mechanized sack-handling and sampling facilities, and a 20,000-ton additional fine storage capacity. A new 120-ton-per-day sulphuric acid plant has been installed to handle converter gases. The arsenic plant has been completely rehabilitated through the installation of new mechanical materials-handling facilities, and a complete dust control system.



FLASH SMELTING in new pilot plant at International Nickel's Copper Cliff smelter (above) will use oxygen and heat from flash roasting to smelt flotation concentrate. Savings will be in fuel cost and byproducts. Inco is also replacing the Orford process.

Inco Develops New Processes

THE WAY IN WHICH technological improvements can help compensate both for rising operating costs and decreasing grade of ore is being demonstrated once again, this time by International Nickel Co. at Copper Cliff, Ont. In the new matte treatment and flash roasting processes, Inco has developed techniques that increase efficiency of copper and nickel recovery and decrease operating cost.

As reported by Robert C. Stanley in his address to Inco shareholders on April 27, 1949, International Nickel is faced with the need for mining lower-grade ores in order to satisfy continuing demands for nickel. In 1938, recoverable grade of ore mined at Sudbury was 43 lb. per ton. In 1948, the nickel recovered from each ton of ore had dropped to 27 lb. despite maintenance of high recoveries. This lower grade of ore inevitably brought upward pressure on costs.

A year ago in *E&MJ* for February, 1948, Carle Hayward noted that International Nickel had been granted a patent for a new process for separating copper and nickel sulphides as they occur in the matte produced in Inco's Orford process. This method is the first large-scale attack on the increased costs referred to in the foregoing.

Owing to various questions that remain unsettled, no information can be given beyond that found in the patent itself. Briefly, however, the new process begins with the cooling matte. The cooling is controlled and delayed so that copper and nickel sulphides crystallize into easily separable components. In addition, a copper-nickel alloy that contains the precious metals, largely platinum, can be formed if there is a sulphur deficiency. The cooled matte is then crushed and treated to separate the components.

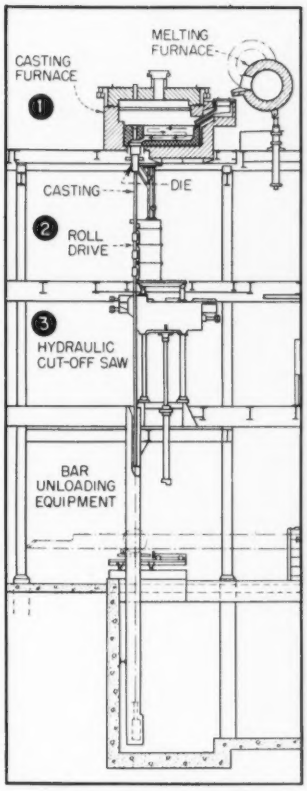
The precious metal alloy can be removed by magnetic separation. The copper and nickel sulphides are then recovered by flotation, using special techniques. The copper sulphide is given conventional treatment, and the nickel product is sintered for use in open hearth and electric furnace steels. This nickel oxide sinter in 1948 made up more than 40% of U. S. steelmakers' total nickel consumption.

This matte treatment operation has proved so successful that it has practically replaced the old Orford process. Transfer of sintering operations from Port Colborne to Copper Cliff will soon be completed.

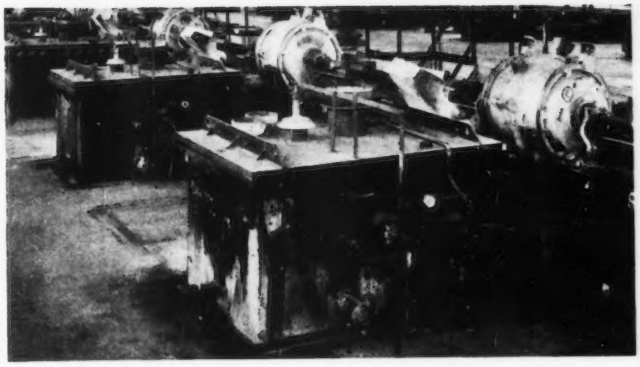
The "flash smelting" process, the second of Inco's important new developments, was reported on briefly by A. W. Schlechten in *E&MJ* for February, 1949. He referred to the announcement that Inco would spend $5,000,000 at Copper Cliff to build a commercial-scale plant for direct flash smelting of concentrates.

In any event, large-scale use of oxygen, perhaps 0.2 ton per ton of concentrate, distinguishes the new Inco technique. The company is building an oxygen plant at Copper Cliff to supply the flash smelting furnace. Advantages in the new process are: considerable saving in coal requirements and increased output of sulphuric acid and allied products. Also, substitution of oxygen for air makes it easier to produce sulphur-containing byproducts, such as liquid SO_2.

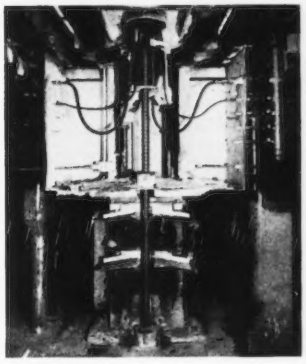
This use of oxygen, plus reports of plants capable of turning out oxygen for less than $0.20 per 1,000 cu. ft., are developments to be watched. Cost and availability of natural gas, electric power, and location of byproduct markets are all factors to consider along with cost of oxygen for smelting. Nevertheless, use of oxygen elsewhere in the non-ferrous smelting field may not be far off.



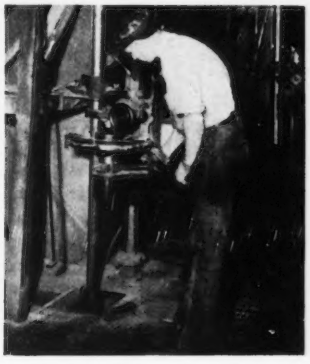
VERTICAL LINE of equipment casts copper-base alloys in various shapes and lengths.



1. MELTING FURNACES on top floor feed casting furnaces where molten metal enters a die or mold chamber to be cast into a wide variety of shapes.



2. ROLL DRIVE regulates speed of water-cooled casting to saw floor below.



3. CUT-OFF SAW travels with the casting cutting it into desired length.

ASARCO'S Continuous Casting Process

FOR MORE THAN 90 YEARS metallurgists have sought to devise a successful continuous casting process for metals. That is why the new continuous process developed by members of the operating and research staffs of the American Smelting & Refining Co. at Perth Amboy, N. J., constitutes a milestone in metallurgical progress. Applied to copper-base alloys, this process not only simplifies the production of accurately-dimensioned castings, but it imparts greater strength and hardness to the alloys than other conventional processes. ASARCO's process also permits the casting of shapes in lengths hitherto not possible by the usual sand-cast and permanent-mold methods. Thus in addition to rods and tubes of indefinite length, hollow rectangles, or even hollow hexagons with circular centers can now be produced. These possibilities open entirely new fields in the marketing and manufacture of metal products.

How the Process Works. Molten copper-base alloys are supplied by batch melting to a casting furnace. The circuitous path of the molten metal in the furnace prevents sloshing action in the die or mold chamber into which the metal flows by gravity. Here, surrounded by a water-cooled jacket, the metal solidifies rapidly. Then the casting travels through a roll drive which regulates the speed of travel to the saw floor below where a saw engages the casting and cuts it into desired lengths during the downward travel. The various stands of the plant are equipped with either automatically or manually operated cut-off saws from which point the casting drops onto a tilting table and is rolled off onto tables on the ground floor for inspection.

The first commercial installation was completed at Perth Amboy for the production of 3-in. copper billets. Following experimental work on a pilot-plant basis, a new plant costing more than $1 million was constructed and put into operation in 1947. This plant now produces rods varying from 7/16 to 4 in. in dia., tubes 1 to 4¼ in. outside dia., and rectangles 1 to 4 in. in width and ¾ in. to 4 in. thick. Castings for machining are furnished straightened, and within a tolerance of +0.004 in., −0.006 in. for the outside diameter. The process is covered by various patents in both the United States and abroad.

THE FUTURE OF MI

ELSEWHERE IN THE WORLD, perhaps even more strongly than in the United States, mining men are looking eagerly and questioningly to the future. Seldom in history has there been a time when the world at large stood in greater need of the products of the mine and the smelter than it does today.

America, as the largest reservoir of venture capital in the world, has both the opportunity and the obligation to play a leading part in world-wide mineral development. Indeed, American mining men have been among the first to respond, where they could, to the invitation expressed in the by-now famous "Point 4" of President Truman's "bold new program" to build up undeveloped areas of the world.

We have only to point to the record shown on the following pages to demonstrate that the entry of American capital into foreign mining enterprises is accompanied by neither the attempt nor the wish to subjugate local interests or obtain undue advantage. For an excellent expression of what it is like to work in cooperation with American venture capital, the reader is referred to the articles on the following pages.

Not everywhere in the world, however, has American capital been accorded the equitable treatment that the reasonableness of its approach gives it the right to expect. For example, it seems only fair that those who invest dollars to help develop a country should be able to expect dollars in return.

There has been growing of late a tendency in certain countries toward exchange controls that have put a tighter and tighter rein on return of investments in dollars. It would be the most short-sighted of policies to let anxiety over a shortage of dollars choke off

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F MINING ABROAD

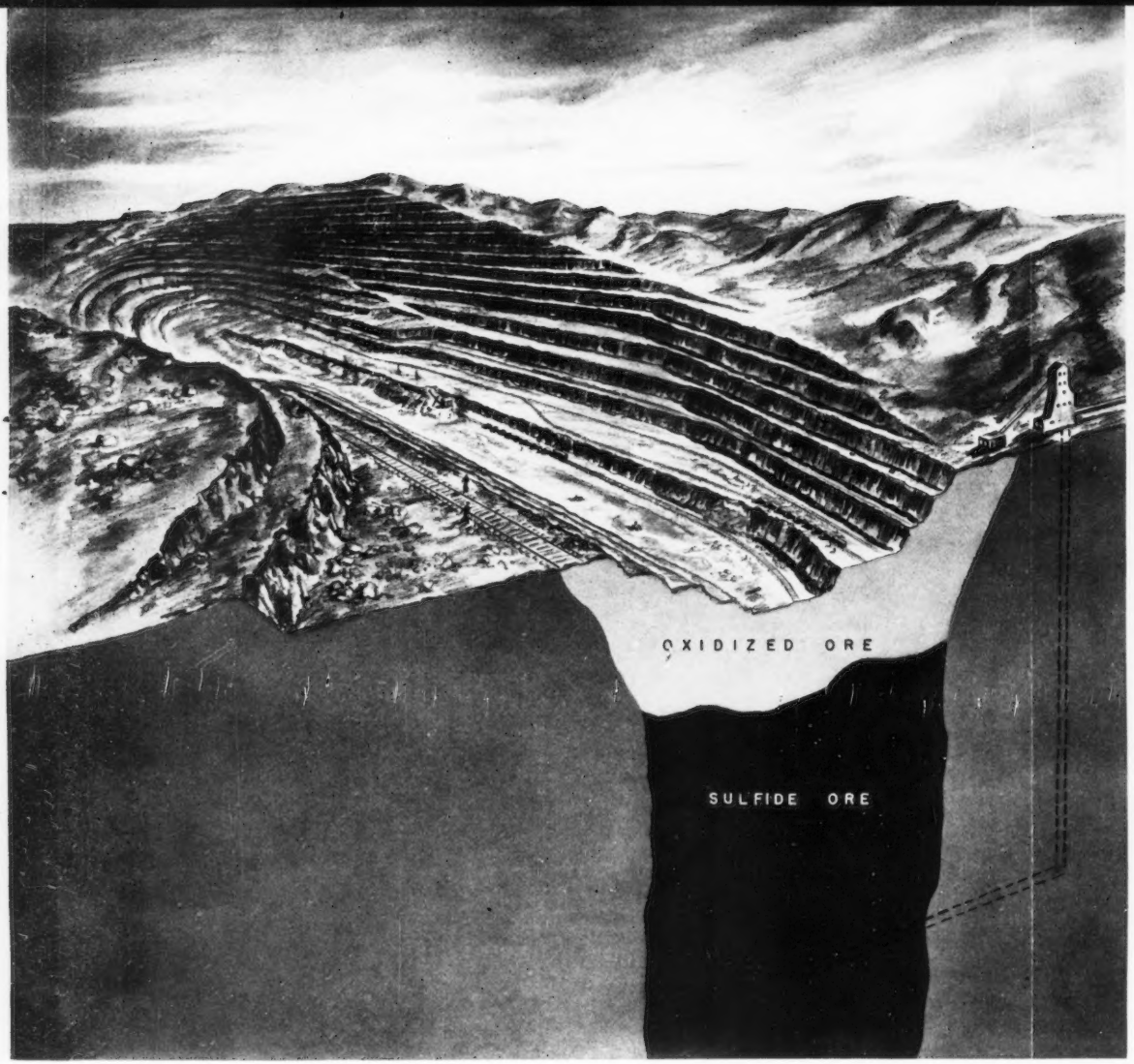
completely the flow of dollar investment into a country. Yet that is exactly the effect of excessive restrictions on dollar exchange.

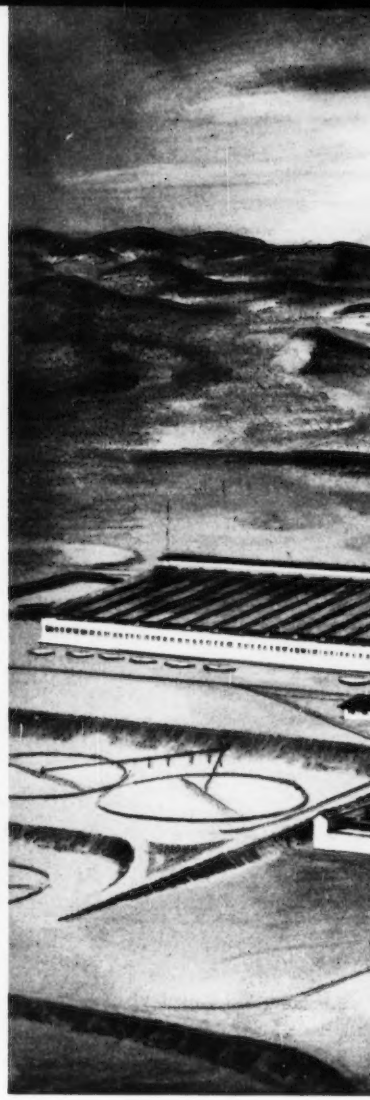
Extremely high tax rates, and other regulatory measures, have lately put an increasing burden on potential investment abroad. American companies have even become willing of late to enter agreements with foreign governments in which the government itself was an active partner. Yet there is one step no American company is willing, or able, to take. That is, to operate without profits.

Under the American system, a profit, be it only a very small one, is the absolute essential to a going concern. American capital, therefore, abroad or at home has no choice but to return a profit or cease to exist.

Mining is a hazardous business at best. We have had a most vivid lesson in recent weeks of the rapid and unpredictable changes that can occur in the markets where mining's products are sold. Common sense would seem to indicate against artificially increasing the hazards between a mining investor and the return of his capital. Private enterprise, in the end, is the most progressive and effective instrument for developing a mineral resource, as this issue amply demonstrates. Only through tax laws, and other measures, that encourage, not discourage, private investment in mining can any government secure full and efficient use of its mineral raw materials.

If these facts are recognized and acted upon, vast projects, such as the one pictured on the opposite page, are only a beginning of the development of which the world is capable. The full flood of that progress will then come, as these developments we have pictured have come, through the efforts of free men working hard for the ideals in which they believe and by which they live.





SULPHIDE ORE MINED BELOW CHUQUI'S PIT . . . . . WILL GO TO NEW MILL AND SMELTER FO

Chuquicamata Begins Building Plant To Treat S

WHAT MAY EVENTUALLY BECOME the largest sulphide copper operation in the world is now taking shape at Chuquicamata in Chile, where Chile Exploration Co., an Anaconda Copper subsidiary, is preparing to start operations on sulphide ore.

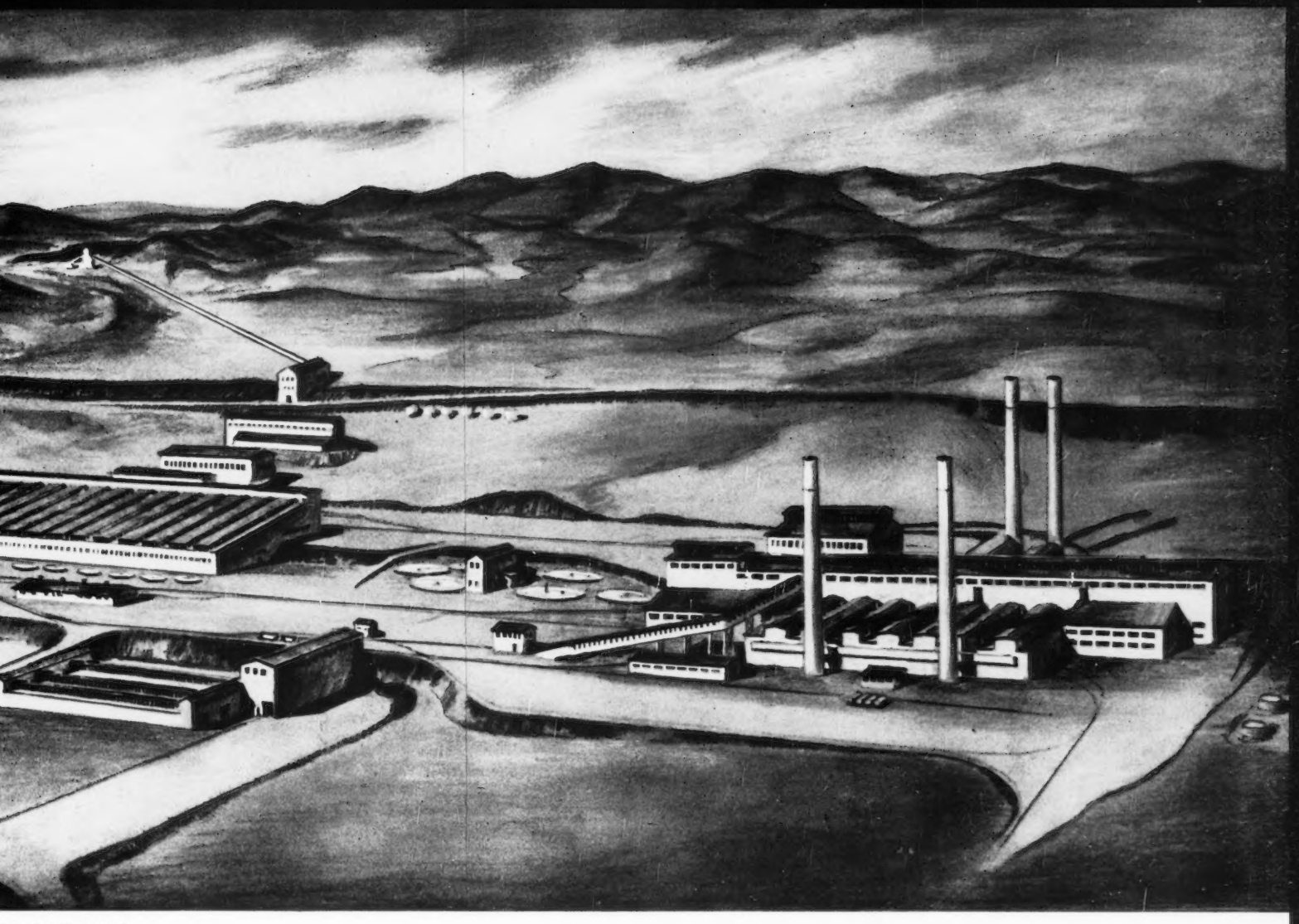
Outlines of the new development, which involves opening up a 60,000-ton underground mine and building a suitable mill and smelter, appear in the above drawings. No artist or camera, however, could do full justice to this enormous undertaking.

Since 1915, when mining began at Chuqui, there has gradually been revealed a copper deposit that is unquestionably the largest in the world.

The mineralized zone at Chuqui is roughly 1.8 miles long and 3,000 ft. wide. It was formed at the end of the Cretaceous period in a quartz monzonite intrusion. The copper minerals were deposited in the altered rock in a complex network of veinlets, stringers, and specks, rather than in a uniform dissemination. Pliocene erosion then exposed this orebody and oxidized the sulphides nearest the surface.

Under this oxide zone there exists an orebody of sulphide copper of undetermined depth. As shown in the drawing at the left, the Chuqui pit has worked down to the point where provision must be made for handling this sulphide ore. In fact, considerable sulphide ore is now available in the pit and the disposition of this sulphide, or mixed oxide-sulphide ore, has complicated the mining problem in the last two or three years.

Chuqui is therefore preparing for the future mining of this sulphide ore by block caving. The pit will, of course, be carried on as long as oxide and sulphide ore



TER FOR TREATMENT

Sulphide Ore

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can economically be taken from it, but it is evident that underground mining must eventually be resorted to.

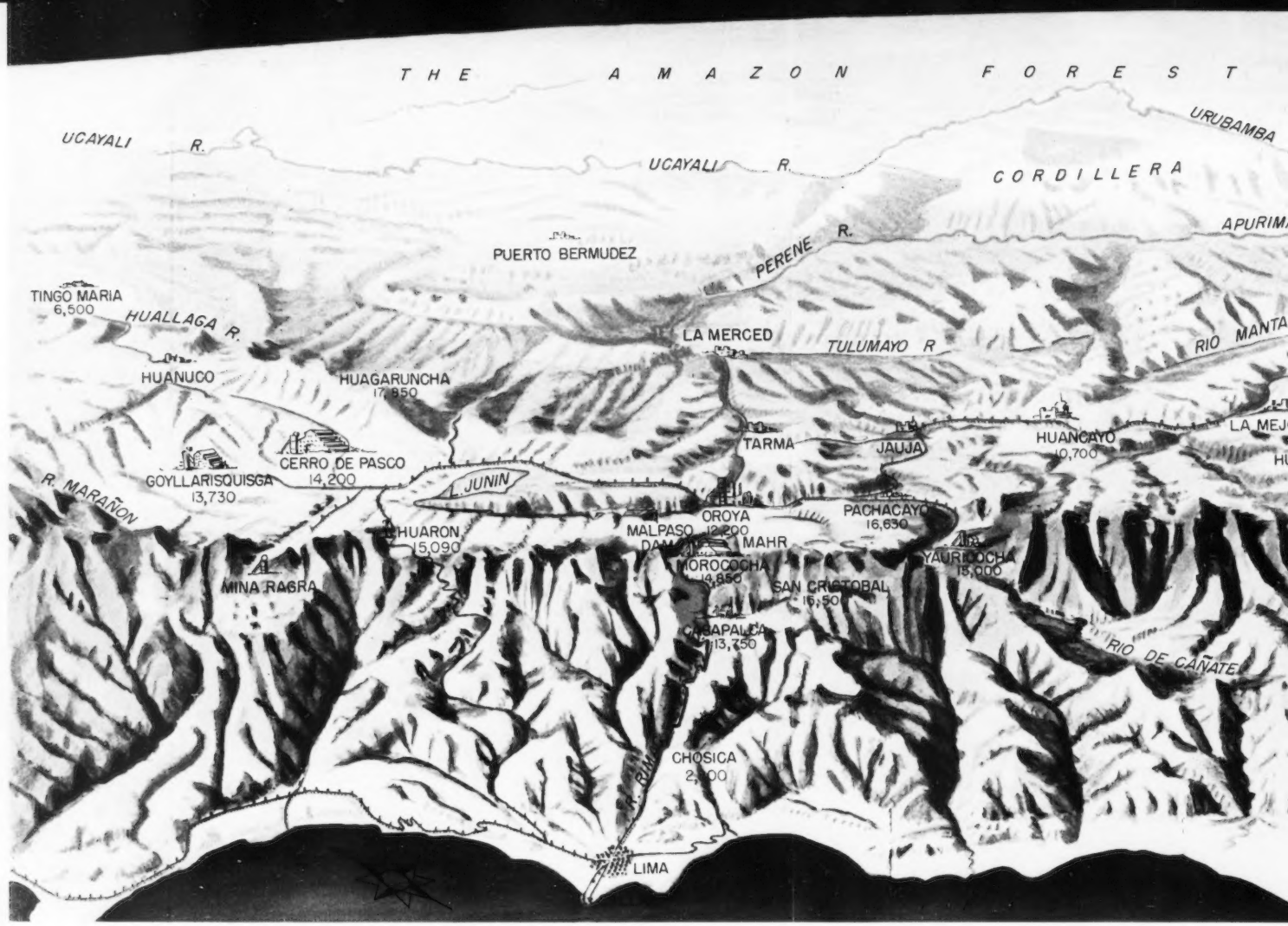
C. M. Brinckerhoff, formerly manager of Anaconda's Andes Copper operation, has been transferred to Chuquicamata as manager. Andes has been known for years to be the largest block-caving operation in the world.

Construction is already under way on the sulphide concentrator and smelter shown in the drawing at the right. Foley Brothers, of New York, has the construction contract. All design work on the new plant was done by Wilbur Jurden, Anaconda Copper Mining Co.'s chief design engineer, and his staff.

The first unit of the mill and the smelter will be able to handle 25,000 tons of sulphide ore daily. As far as is known now, the flowsheets will employ more or less standard procedures, and no particular problem is expected in treating the ore. Additional units will be built over the next 10 years until a capacity of 60,000 tons per day is reached. By 1952, the first unit should be in operation, and its output, added to that of the oxide plant, will give Chuqui capacity to produce 540,000,000 lb. of copper per year.

The first stage of construction will cost about $60,000,000 over the next four years. About half of this will be spent in the United States for equipment, and the rest in Chile for labor and supplies. Cost of the entire program, when it is completed perhaps ten years hence, will be about $135,000,000.

A hopeful sign for American capital investment abroad was seen in a recent announcement by Messrs. C. F. Kelley and James R. Hobbins, chairman and president, respectively, of Anaconda Copper Mining Co. In referring to the starting of the Chuqui project, they said, "Briefly stated, the negotiations between officials of the Chilean Government and those of the company, which have been conducted over a period of several months in a spirit of cooperation and cordial understanding, have resulted in an agreement covering matters of importance in connection with future investment of capital by the company in Chile. The assurances given involve exchange ratios between dollars and pesos, and rates of depreciation and amortization."



NEW MINE (YAURICOCHA) AND REFINERY (AT OROYA) TYPIFY CERRO'S PROGRESS AGAINST MOUNTAIN BARRIERS AND TECHNOLOGICAL

Innovations Mark Cerro De Pasco's New Produ

A GLANCE AT THE ABOVE STRATOSPHERIC VIEW of central Peru shows why Cerro de Pasco inevitably comes first in any discussion of Peruvian mining. The drawing includes about 300 miles, north and south, of central Peru's up-ended terrain, and Cerro's operations, or its related units, are scattered behind the Andes in nearly every part of it.

A mining district in itself, Cerro de Pasco Copper Corporation has, in the 47 years of its life, produced something over a billion dollars worth of precious and base metals. Despite this outpouring of raw materials, many of Cerro's known orebodies remain untapped.

The Andes, towering up so prominently in the above drawing, play an equally prominent part in Cerro's economic life. The company's operations are all at altitudes of 12,200 ft. or more, and high mountain passes or deep, impassable canyons make transportation into or through the region extremely difficult.

Yet remote as it is, Cerro's technical achievements rank among the best in the industry. Its researches in flotation and in metallurgy are well and favorably known. The two units of the company most recently brought into production still further support this reputation for technical alertness. These units are the new mine at Yauricocha and the copper refinery at Oroya.

At Yauricocha, the company is opening up a rich but very puzzling group of orebodies. Ore is so high grade that it can be shipped directly to Oroya for smelting. The puzzling part is in the association of oxidized and sulphide orebodies.

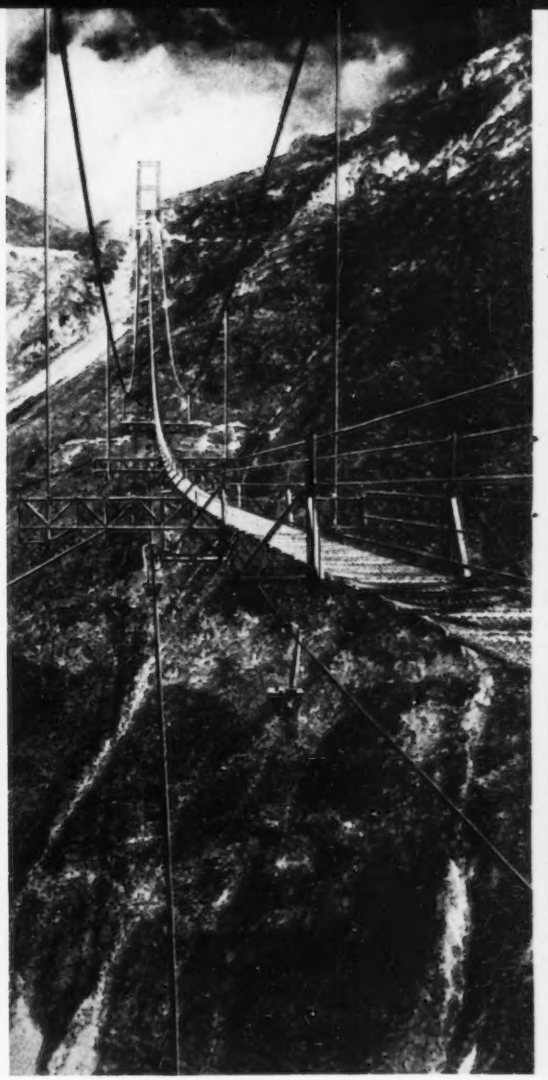
The oxidized ore, malachite, azurite and black oxides of copper in iron oxides, occurs in limestone in a pipe that runs on down for a thousand feet, rich in copper all the way. Nearby is a parallel heavy sulphide orebody unaltered clear to its outcrop. The sulphides are pyrite and enargite.

Deep canyons prevented bringing the standard gage railroad spur from Pachacayo any nearer than Chaucha, 10 miles from the mine. A mono-cable aerial tram

ICAL OBSTACLES.

WIDE ANODE SPACING is required in Cerro's new copper refinery.

FIRST USE of Ignitrons in any electrolytic copper plant.



MONO-CABLE tram swings across 3,200-ft. span with new mine's ore.

ducing Units

e connects Chaucha with the mine. Installed by the
. Roebling Co., this tramway twice in its 10-mile course
d climbs to nearly 16,000 ft. Its buckets simply hang
from the $1\frac{3}{8}$-in. cable; they do not clamp to it.

s Two of the longest spans in the tramway adjoin
e each other. One is 2,166 ft. long, the other is 3,292 ft.
r Both hang about 800 ft. above the valley below. The
- tram carries about 40 tons of ore per hour. Operation
e thus far has proved satisfactory.

The electrolytic copper refinery presents several in-
e novations. For one thing, the cells in the tank house
- are of individually-cast concrete slabs, 32 cells form-
n ing a section. Each tank contains 24 anodes and 25 cathodes. The new plant is rated at 3,000 tons of cathode copper per month, but thus far production has not been pushed beyond 2,300 tons per month.

Cerro departs from conventional practice in that it does not cast anodes from a poling furnace. The blister copper from the converters has impurities that seem to cause trouble in the electrolytic cell only if the blister copper is poled before casting into anodes.

The blister anodes thus carry about 97.5% copper, but they also run about 250 to 300 oz. of silver per ton. The roughness of the anodes, plus the high silver content, make necessary a 7-in. spacing of anodes in the cell. The more common 4-in. spacing might result in short circuits or in silver carrying over into cathodes.

This wider spacing causes a voltage drop of about 0.5 volts per cell. Other operating characteristics are: cathode current density, 20 amp. per sq. ft.; copper content of electrolyte, 40 gpl.; sulphuric acid, 140 gpl.; rate of electrolyte flow, 4 gpm. per cell.

The combined expense on these two projects, including building the railroad spur, the tramway, and the electrolytic plant, came to over $5,000,000. The company has also done pilot plant work on an electrolytic zinc plant, which will require a very large investment if the job is undertaken.

Cerro's total output last year was 14,119 tons of copper, 38,341 tons of lead, 5,700,000 oz. of silver, and 16,087 oz. of gold. High zinc prices brought out 59,000 tons of zinc concentrate that it does not ordinarily sell.

The company's chief problems are largely man-made in the form of high taxation and exchange restrictions. These will be particularly troublesome as metal prices come down. However, Cerro's past accomplishments and the strength of its present position encouraged Frank F. Russell, Cerro's president, to express the belief "that the problems of the future can be met successfully."

1. MINE AT AGUILAR. Concentrates produced here are shipped by truck 50 km., and then by rail to be roasted at Borghi.

2.

Aguilar Participates

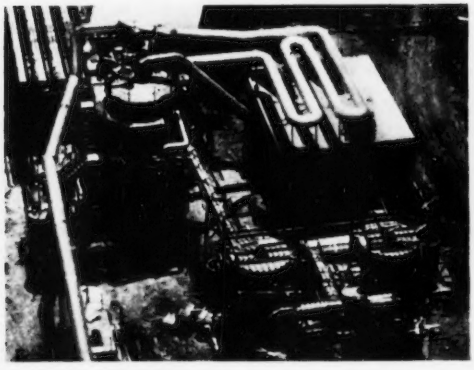
COMPANIA MINERA AGUILAR, S. A., initiated by the St. Joseph Lead Co., is participating in two new projects to develop the mineral wealth of Argentina:

1. The 40,000-ton-per-year sulphuric acid and fertilizer plant of Sulfacid, S.A., at Borghi on the River Plate, which should be in operation soon. Aguilar owns 50% of this plant which will cost about 22 million pesos when completed.

2. The 15,000-ton-per-year electrothermic zinc smelter at Comodoro Rivadavia, which should be operating late this year. Aguilar has a three-eighth's ownership in this 16-million-peso project.

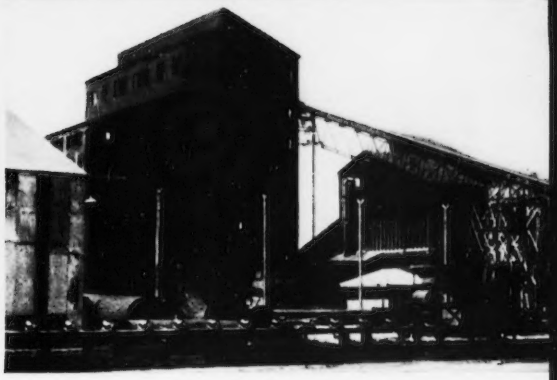
Both plants were designed and purchased in the United States and are of the same general design as the electrothermic zinc smelting plant at Josephtown.

The Mine. Last year the Aguilar mine produced about 190,000 tons of ore yielding approximately 27,000 tons of lead



3. SULPHURIC ACID PLANT at Borghi will have 40,000-ton-per-year capacity. Sintered products will go by boat to zinc plant.

4.



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2. SINTER PLANT at Borghi north of Rosario will treat concentrates. SO_2 from sinter plant will be used in sulphuric acid plant.

pates in New Projects

concentrates and 26,000 tons of zinc concentrates. The property has been operating at 60% of capacity because the Argentine railway cannot handle the full output of concentrates. Local transport of concentrates and mine supplies between the mine and railroad is satisfactorily handled by a fleet of 30-ton diesel-powered trucks.

Responsibility for the welfare and accommodations of employees at the Aguilar mine is shouldered by the company, which provides houses, schools, water, electric power, laundries, post offices, movies and athletic fields for the residents here in the semi-arid Altiplano of the Andean Range some 50 km. from the nearest railroad. Roads, telephone, transportation facilities must also be maintained. In addition the company provides a hospital staffed with nurses, doctors, dentists and pharmacists.

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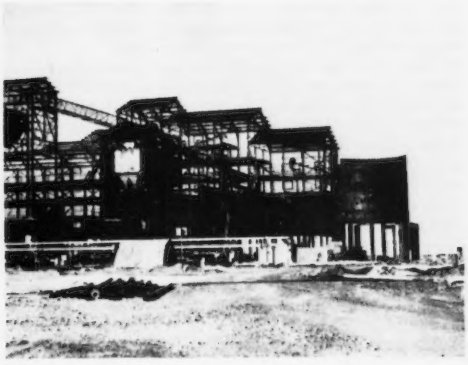
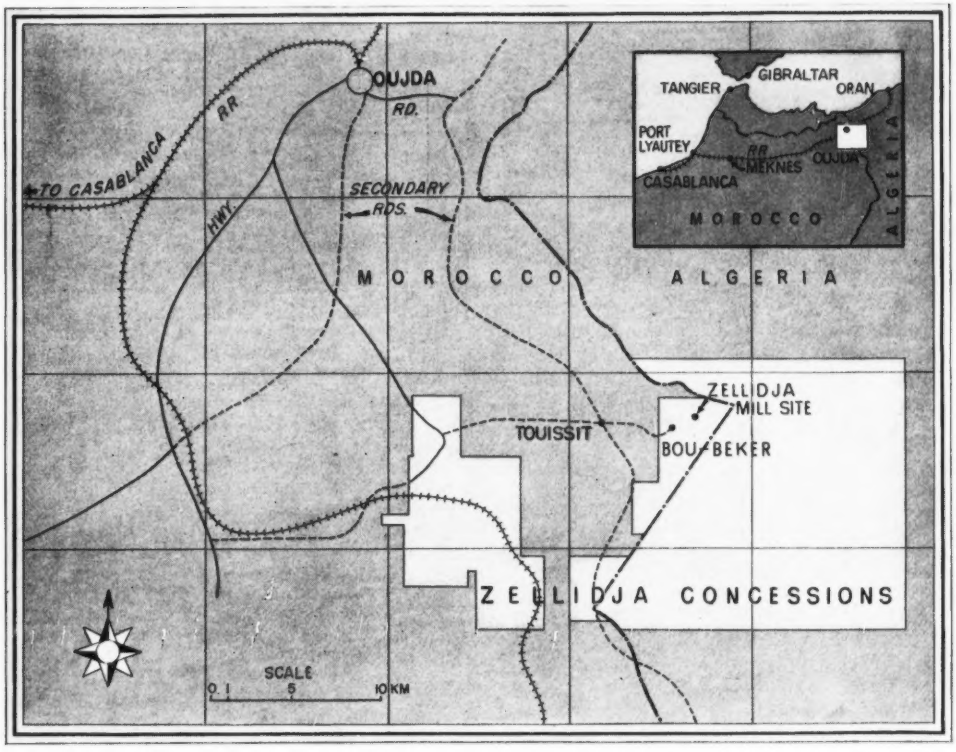
plant.



4. ELECTROTHERMIC ZINC PLANT now being completed at Comodoro Rivadavia. Capacity will be 15,000 tons per year.



FRENCH AND AMERICAN enterprise work together to develop lead-zinc orebodies in this ancient North African mining district.

Zellidja—Study In Cooperation

JEAN WALTER, chairman of "Société des Mines de Zellidja," the French mining company that has most recently achieved a considerable degree of success in the production of lead and zinc in French Morocco, has recently published in France a brochure entitled "Search for World Resources of Metal." By its own terms it has the object of encouraging French-American cooperation in the development of metallic ores in the French Empire.

This publication recites the fact that French capital and mine management are now working with an American group in Morocco and Algeria to help develop one of the world's most promising lead-zinc areas. The Zellidja district, as it is now commonly known, has already proved to compare favorably in reserves with any single such district in the United States.

The area, shown in the above map, is largely taken up by "permis" (the Moroccan equivalent of mining claims) owned by three Moroccan companies: Mines de Touissit," a subsidiary of Cie. Royale Asturienne des Mines, Société des Mines de Zellidja, and Société Nord-Africaine du Plomb. The Zellidja company has given not only the name but the driving force by which the region has gained recent prominence. Chiefly through the faith and energy of Jean Walter, Zellidja's chairman, have the district's full possibilities been made known.

By now, it is apparent that Morocco could become a great metallogenetic province like the Mississippi Valley region, the area around Hayden, Arizona, and the Iron Country. Including the holdings of Zellidja, Asturienne and Nord-Africaine, the lead-zinc mineralization has been proven over a horizontal distance of about 18 km. Much exploration is yet to be done, but the area in the immediate proximity of the Zellidja mine already contains an indicated reserve of 2 million tons of lead in ore that also contains a somewhat greater tonnage of zinc.

Newmont Mining Corp. and St. Joseph Lead Co. own a 9% interest in Société des Mines de Zellidja and a 49% interest in Société Nord-Africaine du Plomb, of which 51% is owned by Zellidja. Newmont acts as Zellidja's purchasing agent in this country and supplies technical and engineering assistance.

Several years ago a large expansion program was decided upon by Zellidja. The daily production was first increased from 250 to 400 tons, and then to 1,000; by late 1949,

milling rate will be 1,500 tons per day. This has been done by mechanizing and modernizing with United States machinery and methods.

More recently, a contract has been signed with a Canadian construction firm to build a new 4,000-ton-per-day crushing plant and a new milling plant, which will have an ultimate capacity also of 4,000 tons. The crushing plant and first unit of the mill are to be completed early in 1951, with most of the equipment for this plant and for increasing underground production coming from the U. S.

Zellidja's planned output for 1949 is 20,000 tons of lead concentrate, running about 70% lead, and 3,000 tons of zinc concentrate, running about 55%.

By 1954, Zellidja hopes to raise output to 85,000 tons of lead concentrate and 120,000 tons of zinc concentrate. This production, based on France's 1948 consumption of metals, and on March, 1949, metal prices, would mean a lead surplus for France of about 59,000 tons of metal, worth $22,200,000. It would still leave France with a zinc deficit of about $6,900,000. (See Table I.)

Table I. How Zellidja's Lead and Zinc May Help Relieve France's Dollar Shortage

In 1948 France consumed:	**In 1954 French production will be:**
	Lead (tons) / Zinc (tons)
81,900 tons of lead	Zellidja 60,000
105,300 tons of zinc	All other... 79,000
	139,000
In 1948 France produced:	Zellidja 55,000
47,360 tons of lead	All other... 30,000
16,000 tons of zinc	85,000
Leaving a deficit of:	If France consumes at about the 1948 rate, this leaves: $22,200,000
34,540 tons of lead—$13,000,000	Lead surplus of 59,000 tons—
89,300 tons of zinc—$31,000,000	Zinc deficit of 20,000 tons— $ 6,900,000
Total deficit—$44,000,000	Net surplus of $15,300,000

Values Long Overlooked

Zellidja, as a mining district, is nearly as old as history. The Carthaginians, and probably earlier races, scratched about there for lead. Later, Roman soldiers under the Emperor Augustus, early in the 1st Century A. D., drove Berber slaves to work in Zellidja's shallow diggings. From then until the early 1920's, there was only desultory development in the center of this potentially rich mining property.

Jean Walter can therefore take particular satisfaction at the results of his efforts in the district. Soon after he first saw the country in 1925, he was convinced of its potentialities, but it was not until 1936 that he could get significant development work under way. In this he was materially aided by Jacques Segaud, consulting geologist.

Near the small, sun-baked, Arab town of BouBeker (the Asturienne concessions center about the nearby town of Touissit), Walter and Segaud outlined substantial tonnages of ore running 6% to 7% lead. With this encouragement, the Moroccan Government put in a railroad and the Zellidja company built a small mill. Output in 1937 was 3,177 tons of lead concentrate.

Lack of power and other difficulties of the war years cut production, but by 1944 news of developments at Zellidja had spread. Gardner of the U. S. Bureau of Mines reported on the district in that year and on a later visit, E. R. Stettinius was so impressed with the region that he cabled back a recommendation for lend-lease aid. With this help, a 1,000-ton mill was planned, but it was not completed until July, 1948. Capacity is now being increased to 1,500 tons daily by installation of new equipment.

Following some further investigation, Zellidja on the one hand, and St. Joe and Newmont on the other, in November, 1946, signed the agreement already mentioned for modernization of the mine's operations.

Jean Walter gives credit in these terms to his American associates: "Thanks to American aid, Zellidja has contributed to the world resources of metal, the company has doubled its reserves of lead, and has discovered a deposit of zinc which is of greater importance than that of lead. The exploration conducted by the Franco-Americans has made infinitely more progress in two years than the French company alone was able to achieve in ten years."

Zellidja's orebodies are of the manto type, quite similar to those found in the Mississippi Valley. They occur in one or two main flatlying horizons in the upper Lias limestones and dolomites, within a stratigraphic range of about 20 meters.

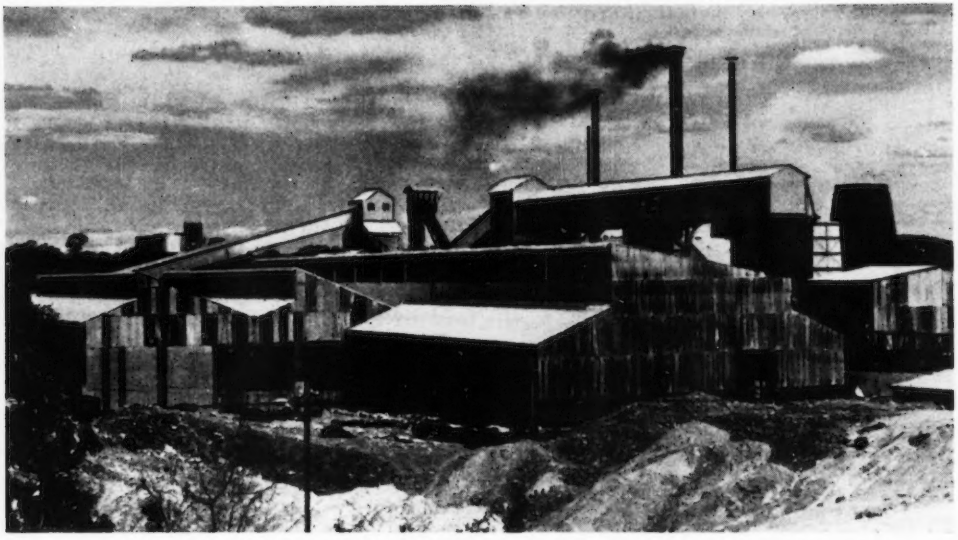
Galena and sphalerite occur in veinlets, as well as disseminated, and in irregular networks. Thickness of the mineralized zones runs from 4 to more than 40 ft. Average thicknesses of commercial impregnations are usually from 6 to 15 ft.

These beds were originally worked from adits driven into the southern slopes of the hills northeast of Bou-Beker. Faults displace these orebodies, which were in fact probably mineralized via the fissures of a fault zone that elevated the "Horst of Bou-Beker," which trends north-northeast across the Moroccan-Algerian boundary. Future mining and development will be through vertical shafts.

Mining thus far has involved silling out stopes from the adits or from small levels run from "*descenderies*" (incline shafts). Formerly support for the back has been drywall filling with sandstone blocks brought into the mine. These methods are being replaced by procedure similar to that used in the mines of S. E. Missouri.

Ten to twenty percent of the lead in much of the area exists as cerussite, which requires three flotations in the milling flow sheet. After recovery of galena and sphalerite, sulphidizing with Na_2S, a third flotation in a separate circuit is required to recover this oxidized lead. Water for milling on a 5,500-ton basis is a major problem and will require one or more long pipe lines.

Taken all in all, Zellidja would seem to be well worth watching, both for the sizable bulge it makes in the world's lead-zinc ore reserve and for the interesting political and economic results noted by Walter. Zellidja shows how American capital and technical experience can be made to work amicably and profitably in a foreign enterprise and how—in the words of Jean Walter—"much more due to free enterprise than by Government aid (the Franco-American company), is on the way to improve the foreign exchange balance of France by more than $40,000,000."



NEW 1,200-TON MILL at Tsumeb Corporation's copper-lead-zinc mine in South-West Africa. Formerly operated by German company, mine is now being developed by combined American-British capital. Mill's patchy wall is owing to emergency use of available sheet.

Africa Aids An Enterprise

TSUMEB CORPORATION, LTD., the company now operating a reopened lead-zinc property in South-West Africa, forms one of the most interesting mining developments in recent years. The reasons for that statement are two-fold.

First, the company has been extremely fortunate in the quality of the leadership it has had, in the quantity and grade of ore that has been available to it, and the encouraging atmosphere provided this new company by local governments.

Second, the company has met, and is continuing to meet, geological and metallurgical problems the solutions of which will prove highly interesting and instructive.

Based on Tsumeb's experience, it would seem that the Union of South Africa is one of the most favorable areas in the world for investment of capital in mining enterprises. Mining men are particularly sensitive to tax problems because of the greater risk in mining ventures than in other forms of business. In the Union, a new mining venture is permitted to recover virtually all its original capital investment before the Government begins to collect an income tax. Furthermore, investors from abroad are permitted to convert pounds into dollars at the official rate, which is in marked contrast to the artificial, and sometimes ruinous, exchange rates that have been fixed in some other countries for American-owned enterprises.

Tsumeb Corporation, the largest stockholders in which are Newmont Mining Corporation, American Metal Co., O'Okiep Copper Co., Selection Trust, Ltd., and Union Corporation, was incorporated in January, 1947, to buy and operate the Tsumeb mine in the mandated territory of South-West Africa. Tsumeb, first opened in 1908, was operated until 1940 by the Otavi Mining & Railway Co., a German concern. It was put up for sale by the Custodian of Enemy Property of the Union of South Africa, and

Table I. What Tsumeb Did In Its First Two Years

	Year ended	Six months ended
Metals accounted for by smelters	June 30, 1948	Dec. 31, 1948
Copper, lb.	10,461,298	7,596,953
Lead, lb.	33,242,043	32,745,458
Zinc, lb.	nil	4,645,950
Cadmium, lb.	59,869	232,861
Silver, oz.	321,796	225,301
Total sales	$7,604,377	$8,862,732
Operating profit	$3,319,723	$4,494,148
Depreciation	$1,393,248	$1,050,080
Taxes	$ 380,000	$ 678,720
Net profit	$1,546,475	$2,765,348
Profit per share (1,000,000 shares outstanding)	$1.55	$2.77

the group that later formed Tsumeb Corporation made the highest bid, which was $4,010,000.

The Tsumeb orebody is a pipe-like body of sulphide ore in dolomite found on one steeply-dipping limb of what appears to be a large synclinorium. Despite extensive mining and drilling, the geological structure of the orebody is by no means clear, rather complex relationships having appeared as work progresses.

The ore is rich in copper, lead and zinc and carries some cadmium and silver. The Germans had opened the orebody through a shaft and two successive winzes down to about 1,900 ft. By 1940, the mine had yielded about a million tons of high-grade copper-lead-silver ore, which had gone overseas for smelting. When Tsumeb took over the mine, the workings were flooded and the surface plant badly deteriorated.

Otavi's records, however, showed that underground reserves totaled 567,106 tons of ore running 8.38% copper, 20.90% lead, and 10.90% zinc, all above the 20th level of the mine. In addition there were immediately available surface dumps totaling 329,300 tons of ore running 5.42% copper, 17.46% lead, and 13.57% zinc. The underground reserves also carried about 0.04% cadmium for each percent of zinc and 0.6 oz. silver for each percent of copper.

Under the direction of H. DeWitt Smith, managing director, and M. D. Banghart, general manager, the new company set about building a 900-ton selective flotation mill (later expanded to 1,200 tons), unwatering and developing the mine, buying and erecting a 6,000-hp. diesel power plant, and reconditioning and expanding the former owners' townsite and other plant buildings. For this purpose, a sum of $8,800,000 was allocated, including the purchase price of $4,010,000.

Considering the difficulties of supply and manpower current at that time, it is remarkable that in 18 months from the time of incorporation this whole program had been completed. It is a tribute to managerial skill in planning the best use of the manpower and materials immediately available.

In addition to the foregoing, Tsumeb Corporation immediately began hand-sorting and shipping high-grade ore from the mine dumps. As soon as possible, a small jig plant was set up to replace the hand-sorting job. These early shipments provided an excellent income and Tsumeb's net profit for fiscal 1947 (see Table I) was $1,546,475.

Diamond drilling below the 20th level in the mine has been sufficiently favorable that the company now plans to spend about $2,120,000 to sink and equip a new shaft, which will permit handling about 2,000 tons of ore per day. This expenditure will be controlled to some extent by the findings of exploration now under way in the orebody itself, but it is planned to put in this shaft over the next two or three years. The expense will be financed out of earnings.

Expenditures of this kind, after June 30, 1949, can be written off, for tax purposes, in the year in which they are incurred. This is a policy recently decided upon by the legislative assembly of South-West Africa.

Tsumeb's flotation mill makes a copper-lead concentrate running about 42% lead, 11% copper, and 6.7 oz. silver. Its zinc concentrate runs about 47% zinc and 1.7% cadmium. Practical means of separating the copper and lead by flotation have not yet been found, but work to that end is in progress.

The copper-lead product is smelted, half of the output going to El Paso and half to Hoboken, Belgium. Shipments of zinc concentrate go intermittently to Europe. Zinc production is new to the Tsumeb mine, inasmuch as the former owners made no attempt to recover the zinc content of the ore.

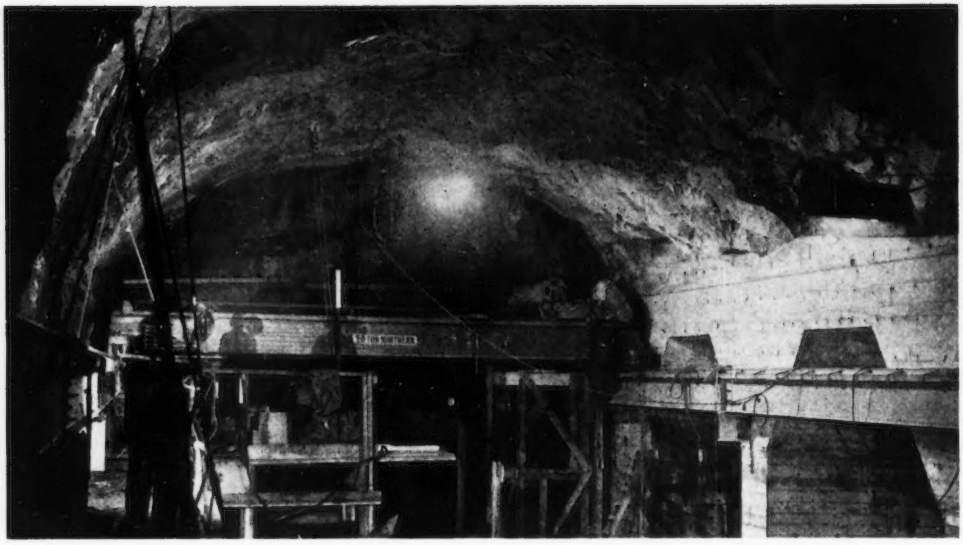
It is possible that Tsumeb may eventually build a smelter at the mine, but that decision will have to wait until more is known about the metallurgical characteristics of the ore now being blocked out. Direct smelting of the copper-lead concentrate remains something of a problem. Also, the recovery of cadmium from the zinc concentrate must be studied further.

In any event, it is apparent from the production figures given in Table I that Tsumeb has already taken a place among the world's leading producers of non-ferrous metals. If a particularly successful start can be regarded as an augury, Tsumeb's rank among those producers may be expected steadily to grow.

A WORD ABOUT THIS ISSUE OF E&MJ

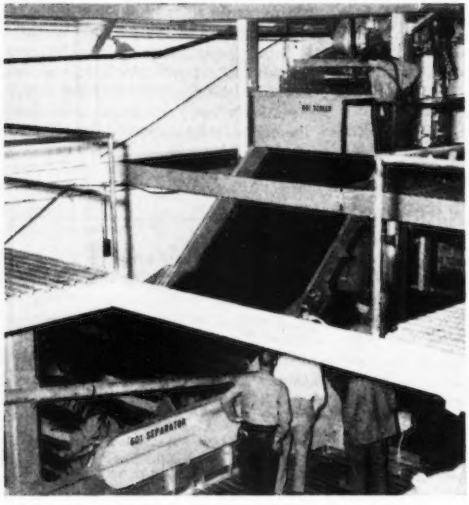
IN PRESENTING THIS CROSS SECTION of enterprise in the mining industry, we should like to acknowledge our debt to the men who made this issue, *Mining Looks To The Future*, possible. We refer not only to the more than 100 individuals in mining companies who contributed editorial material, but also to all those others whose accomplishments, though not recorded here, are equally effective in keeping the mining industry strong. Working on this issue has given us a new insight into the real character of mining men, and again we say that we are truly proud to be working with them. To the following organizations, whose direct assistance produced this issue, and to all members of the mining industry, go our sincere thanks and our enduring admiration.

American Cyanamid Co.
American Smelting & Refining Co.
American Zinc, Lead & Smelting Co.
Anaconda Copper Mining Co.
Atomic Energy Commission
Battelle Memorial Institute
Bathlehem Steel Corporation
Bunker Hill & Sullivan M. & C. Co.
Bradley Mining Co.
Calumet & Hecla Consolidated Copper Co.
Castle Dome Copper Co.
Cerro de Pasco Copper Corporation
Chile Exploration Co.
Cia. Minera Aguilar
Consolidated Mining & Smelting Co. of Canada, Ltd.
E. I. DuPont de Nemours & Co.
Eagle-Picher Mining & Smelting Co.
Electro-Manganese Corporation
Feldspar Flotation Corporation
The Glidden Co.
Gold Mines Consolidated Co.
M. A. Hanna Co.
Hollinger Cons. Gold Mines, Ltd.
Humphreys Investment Co.
Illinois Zinc Co.
Inspiration Con. Copper Co.
International Min. & Chem. Co.
International Nickel Co.
Kennecott Copper Corporation
Ray Mines Division
Utah Copper Division
Chino Mines Division
Lucky Friday Silver-Lead Mines Co.
Magma Copper Co.
Manganese Products, Inc.
Miami Copper Co.
Montana Phosphate Products Co.
National Lead Co.
New Jersey Zinc Co.
Newmont Mining Co.
Oglebay, Norton & Co.
Pend Oreille Mines & Metals Co.
Phelps-Dodge Corporation
Potash Company of America
Republic Steel Corporation
St. Joseph Lead Co.
San Manuel Copper Corporation
Sidney Mining Co.
Simplot Fertilizer Co.
Sullivan Mining Co.
Tri-State Zinc, Inc.
Tsumeb Corporation
United States Potash Co.
United States Steel Corporation
U. S. Vanadium Co.
University of Arizona
University of Minnesota, Mines Experiment Station
Vanadium Corp. of America
Soc. des Mines de Zellidja



CRUSHED UNDERGROUND, Sullivan ore will be treated by sink-float for cost saving. Note crushing chamber's nicely arched back.

Design For Increased Savings



COARSE CRUSHING to 1½ in. is all most of Sullivan ore will get. This Sink & Float separator returns siliceous gangue for stope filling.

THREE OPERATING IMPROVEMENTS, started in 1946 at the Sullivan property of Consolidated Mining & Smelting Co. of Canada, Ltd., will be completed this year. They are: a new main haulage system from mine to mill; an underground coarse crushing plant; a sink and float plant for pre-concentration.

The haulage system required a 10x12-ft. tunnel for 11,250 ft. of the 22,500 ft. between mine and concentrator. A new surface right-of-way completes the system. Two 40-ton locomotives, rated drawbar pull of 20,000 lb., will each handle 40-car trains of 800 tons live load. Cars will be loaded from a 15,000-ton storage bin underground and will be dumped at a five-car rotary dumper at the 6,000-ton mill bin.

The crushing plant is underground. It will crush run-of-mine to 1½-in. size in two stages. A 36x48-in. jaw crusher will be fed from a 6,000-ton mine ore bin. The 5-in. product goes to a 7-ft. Symons, and the 1½-in. discharge goes to the storage bin for transport. Room has been left for doubling both stages if required.

The Sink and Float plant was decided upon when it became apparent that gravity concentration could reject a large part of the ore's insoluble content at a coarse size. Need for achieving this saving grew out of the increasing siliceous material content of the Sullivan orebody at greater depth and in lateral extensions. An H. & H. Sink and Float plant was installed and recently began operating.

From the 6,000-ton mill bin, the 1½-in. ore is fed to two sink-float units, each of 250-tons-per-hour capacity. The galena medium comes from the mill circuit. Sink material goes directly to the new large rod mill (12x11½-ft.) and on through the normal mill circuit.

Float is mixed with 5 to 10% of iron sulphide mill tailing, then returned to the mine via main haulage. It should serve excellently as stope backfilling, for both experience elsewhere and tests at the mine have shown that this rock-pyrite mixture cements into a hard mass in the stopes.

THE BUCHANS MINE is 5 miles north of Red Indian Lake in central Newfoundland. Newly built town of Buchans is close by.

Buchans Finds New Orebody

A DRILLING PROGRAM carried on by the Buchans Mining Co., employing six to eight surface machines, discovered and delineated a new orebody last year, not far from the important Lucky Strike orebody in Newfoundland. The discovery will add about eight years to the operating life of the property. Plans are now being completed for the sinking of a new shaft directly to the 1,500-ft. level.

Discovery came about as a result of the company's vigorous exploration program through its large holdings which include the area within a 30-mile radius of the camp. More recently, this work has been extended to more distant areas where conditions were considered favorable for the deposition of ore minerals. Further expansion of the program is planned. Exploration is being carried on by four geological and geophysical parties transported and serviced by a company-owned plane.

Buchans Mining Co., Ltd., is a wholly-owned subsidiary of the American Smelting and Refining Co., organized in 1926 to undertake development, equipment and operation of the Buchans mine. The project required construction of a 23-mile railroad, a hydroelectric power plant, dock facilities and erecting the town of Buchans.

The Buchans mine is five miles north of Red Indian Lake in central Newfoundland. Elevation is about 900 ft. above sea level. The flat to gently sloping terrain is covered by bogs, small ponds and lakes under which lies a mantle of glacial drift. Rock outcrops are few.

Below the 10 to 50-ft. thickness of glacial drift, the Buchans rocks consist of basic lavas, agglomerates, tuffs, arkose and other fine grained siliceous sediments 100 to 1,500 ft. thick. These rocks have been intruded by granite, diabase and porphyries of pre-Carboniferous age, in the form of sills and other irregular masses. Folding, shearing or fracturing and sulphide and barite mineralization took place after the intrusion. Mineralization appears to follow the axis of an anticline plunging to the north and northwest. Orebodies vary in thickness up to 200 ft.

The ore is a fine grained dense intergrowth of sphalerite, pyrite, galena, chalcopyrite and barite. Considerable portions of the sulphides are particles less than 50 microns in size with many grains less than 10 microns. The sulphides in the lower-grade baritic ores are coarser.

At present, approximately 1,300 tons per day are being milled at the property. Up to 1936, the two major products were a lead-copper concentrate containing some gold and silver, and a zinc concentrate. In 1936, separation of a copper concentrate from the lead was accomplished and a new mill circuit incorporated.

Mining methods include glory-hole mining which accounts for about 20% of the ore, cut and fill stopes, open stope and square set stopes. About 78% of the ore is produced by the latter method.

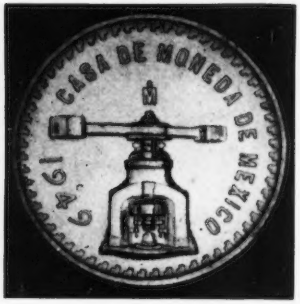
Buchans, the company town, features modern construction. It consists of some 250 workmen's dwellings, mess hall and bunkhouses for 500 men. There are three independent retail stores, a movie theatre, four churches, schools, library and hospital. For recreation, there are a Community Center, hockey arena, swimming pool, bowling alleys, billiard rooms and even six Snipe class sailboats.

No roads connect Buchans with other towns, but during the summer the company operates a bus over its own roads to Red Indian Lake and other points. Within two miles is the excellent Buchans Airport, owned and operated by the Canadian Department of Transport. It has two large runways 4,500 ft. long and 500 ft. wide. During the war large bombing planes frequently used the Buchans field.

The company-owned Buchans Railway connects with the Government Railway at Millertown Junction, 36 miles away. All concentrates are hauled over this line to Botwood, a seaport on Notre Dame Bay, where the company owns a dock, storage shed and Gantry cranes.

Power is supplied at Buchans by the company's 2,000-hp. hydroelectric plant. An additional 3,000 hp. required for operation is purchased from Bowater Newfoundland Pulp and Paper Mills, Ltd.

NEWS OF THE INDUSTRY



ONE-OUNCE SILVER DISC shown is part of a plan by Rodrigo Gomez, subdirector of the Bank of Mexico, to use silver as a medium of exchange in world trade.

Mexican Bank to Market Silver "Barter Coin"

Silver producers are interested in an experiment now being worked out in Mexico for merchandising silver in the form of a circular disc or "barter coin." It has been the hope of the Mexican authorities for years to develop what amounts to a substitute for the old Mexican silver dollar that served extensively as a medium of exchange in world trade, particularly in the Far East. Rodrigo Gomez, subdirector of the Bank of Mexico, has prepared what he refers to as a number one plan to make silver work for Mexico as an asset instead of a liability under the shrinking use of the metal in coinage.

The plan involves the stamping of a circular disc that contains exactly one ounce of pure silver. With foreign silver currently available at 71½c. an ounce troy, New York, the value of the disc or "barter coin" is approximately 72c. The Bank of Mexico has distributed discs to banks and brokers in leading financial centers and has asked for frank comment on the plan.

Resembling a coin, one face shows a pair of scales and the word "One Ounce Troy—480 grains pure silver. Legal standard of quality 0.925 fine." The other face shows an ancient coin press, emblem of the Mexico City Mint, and the words "Mint of Mexico, 1949—Weight 33.625 grams." The disc has a diameter of 41½ millimeters, and is 3 millimeters thick.

The United States silver dollar weighs 26.7296 grams and is 0.900 fine. It contains 371.5 grains of fine silver.

Sponsors of the plan point out that the disc could be sold to the jewelry trade where small quantities are called for, as its purity is such that the resultant product could bear the imprint "sterling."

Mexico's silver dollar invaded China as a medium of exchange in 1850 and ruled supreme in that country for 60 years, becoming legal tender. China's paper currency now in circulation is virtually valueless.

Since last December the foreign market for silver has been relatively stable on support from the Bank of Mexico in the form of purchases of its surplus metal for coinage purposes.

To Test Uranium Ore

A test kit of standardized samples and typical specimens of Arizona uranium ore can now be obtained from the Arizona Assay Office, 815 North First St., Phoenix, Ariz., for $5.00. Characteristics of each test sample is marked on its container. A complete set of instructions is furnished for using the test kit with a Geiger counter on unknown samples of ore.

The Arizona Department of Mineral Resources aided the Assay Office in compiling these kits but announces that the department is not in a position to furnish samples. Charles H. Dunning, director of the Mineral Resources Department, suggests that anyone wanting samples of uranium ore for testing purposes would find the $5.00 kit well worth the price.

Act Waives Assessment

On June 17 the President signed HR 1754, suspending for another year annual assessment work on mining claims held by location in the U. S. This allows miners to wait until July 1, 1950, before starting the work. Alaskans may wait till that date, too, as a bill passed last year waived such work there for two years.

Kennecott in Africa

Kennecott Copper Corp. is to participate in developing a gold mining lease area in the Virginia district of the Orange Free State. The lease is under control of Middle Witwatersrand (Western Areas), Ltd. The announcement was made on June 20 after closing of an agreement between the copper company and the recently formed Anglo-Transvaal Cons. Investment Co., Ltd. Kennecott is to contribute about $10 million to the Free State venture.

In view of the fact that this is the first such working partnership between an American mining corporation and a South African house, the South African Government granted substantial reduction in the lease formula under which the new company will operate.

Rioters Kill Engineers

A strike of Bolivian tin miners brought on a riot at the Patiño mine at Sigio Veinte (Twentieth Century) which involved fighting with dynamite, guns and clubs. At least thirty persons, including two American engineers, were killed late in May.

Matmerto Urriolagoitia, acting President who recently succeeded middle-of-the-road President Enrique Hertzog, had ordered a round-up of labor and political elements which the Government charged with efforts to foment strikes in the tin mines. Government agents arrested about 26 persons, including union and political leaders and army men. The miners, in protest, seized 15 American, Bolivian and Argentine hostages.

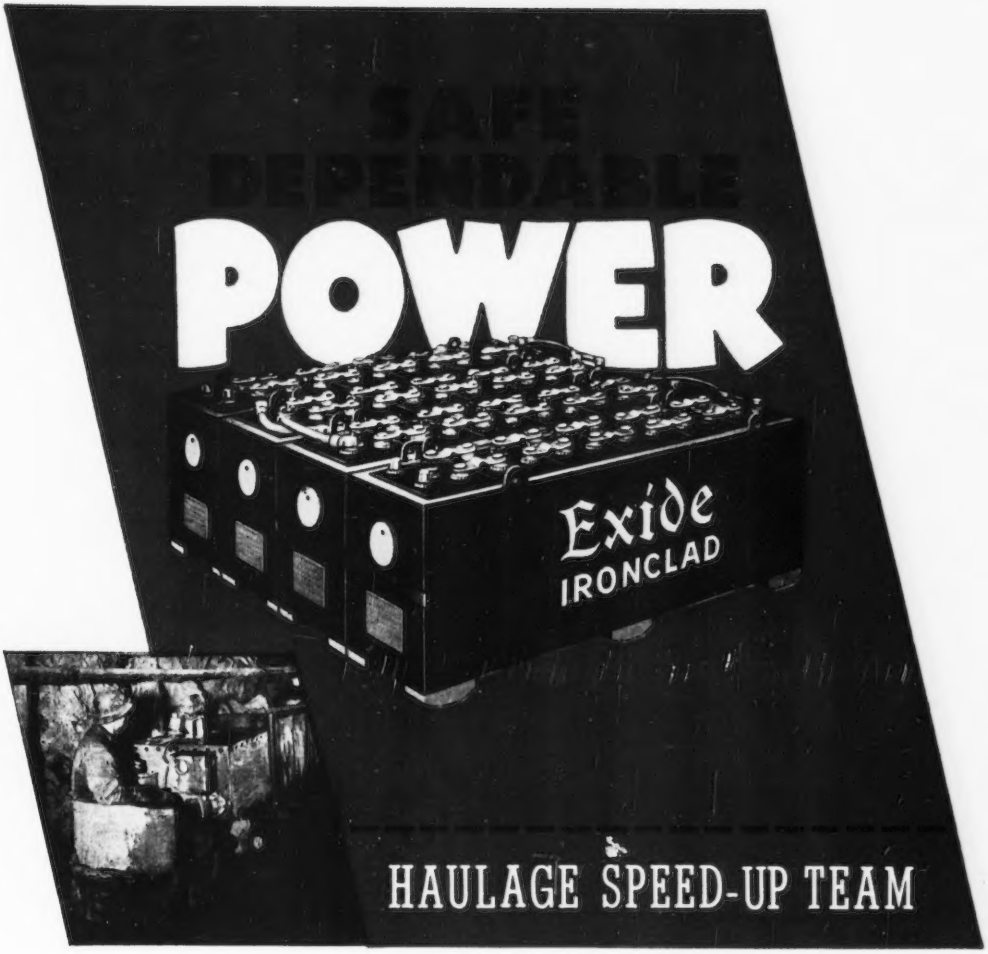
Most mines reopened by June 9 after the Government agreed to return exiled labor leaders for trial.

MMSW Accepts a Cut

A contract calling for a reduction of $2.25 per shift in the basic wage rate was signed on May 10 by a local of the CIO Mine, Mill and Smelter Workers Union and the management of the St. Louis Smelting & Refining Division of the National Lead Co., at Baxter Springs, Kansas, in the Tri-State mining district.

The new contract also provides for a sliding scale of eight cents per shift, up or down, for each dollar of change in the Tri-State price of zinc concentrate.

Pressure on operating costs has been severe, owing to the fall in the price of slab zinc. This is the first negotiated contract reported in the mining industry since the war that provides for a wage decrease.



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Exide-Ironclad Batteries are different from all others. They have all four of the characteristics that a storage battery must have to assure maximum performance from mine locomotives, trammers and shuttle cars—high power ability, high electrical efficiency, ruggedness and a long life with minimum maintenance. The combination of these four Exide-Ironclad characteristics assures years of day-in, day-out service with dependability and economy.

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THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • *Exide Batteries of Canada, Limited, Toronto*

MARKETS—Trends and Prices

PRICE ADJUSTMENTS in major non-ferrous metals continued during June, forcing copper down to 16c., Connecticut Valley, and Prime Western zinc to 9c., East St. Louis. Lead, the first metal to break last March, firmed up appreciably toward the end of the month on a revival of buying, inspired in part by renewed purchases for the Government's stockpile. Demand for copper also improved and the market steadied for similar reasons. Zinc remained inactive on continued uncertainty over the trend of galvanizing and die-casting operations. Producers are returning to the 40-hour work week to reduce output and cut production.

The E&MJ index of non-ferrous metal prices declined in June to 131.20, which compares with 148.05 in May.

That the industry has passed through one of its most trying periods is brought to light by domestic deliveries in the Jan.-May period, figures in tons:

	(a) Copper	(a) Lead	(b) Zinc
January	94,070	50,440	76,234
February	97,861	41,652	68,522
March	113,154	28,368	71,017
April	76,134	16,743	53,143
May	32,566	19,792	51,938

(a) Shipments to domestic consumers. (b) Includes exports and deliveries on Government account.

Sales of lead in the last week of June totaled 16,807 tons, against 7,068 tons in the preceding week. The Government may absorb 50,000 tons of lead in the next three months. The lead import duty was restored automatically July 1.

Copper also moved into a better position. Stockpile prospects and a tighter scrap market restored confidence in the price outlook. The labor dispute at Utah Copper has not yet been settled. Production at Chile Exploration and Andes is being curtailed 30%. Katanga, Belgian Congo, has reduced output, owing to a water shortage.

Major Metals

U. S. DAILY AND AVERAGE PRICES

June 1949	Electrolytic (a) Domestic	Copper (b) Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc East St. Louis
1	17.325	17.550	103.000	12.000	11.850	11.000
2	17.325	17.550	103.000	12.000	11.850	10.750
3	17.325	17.550	103.000	12.000	11.850	10.750
4	No Market	17.550	103.000	12.000	11.850	10.750
6	17.325	17.550	103.000	12.000	11.850	10.750
7	17.325	17.550	103.000	12.000	11.850	10.750
8	17.325	17.250	103.000	12.000	11.850	10.000
9	16.700	16.925	103.000	12.000	11.850	9.500
10	16.700	16.925	103.000	12.000	11.850	9.500
11	No Market	16.925	103.000	12.000	11.850	9.500
13	16.575	16.425	103.000	12.000	11.850	9.500
14	16.200	16.425	103.000	12.000	11.850	9.500
15	16.200	16.425	103.000	12.000	11.850	9.000
16	16.200	16.425	103.000	12.000	11.850	9.000
17	15.700	15.925	103.000	12.000	11.850	9.000
18	No Market	15.925	103.000	12.000	11.850	9.000
20	15.700	15.925	103.000	12.000	11.850	9.000
21	15.700	15.925	103.000	12.000	11.850	9.000
22	15.700	15.925	103.000	12.000	11.850	9.000
23	15.700	15.925	103.000	12.000	11.850	9.000
24	15.700	15.925	103.000	12.000	11.850	9.000
25	No Market	15.925	103.000	12.000	11.850	9.000
27	15.700	15.925	103.000	12.000	11.850	9.000
28	15.700	15.925	103.000	12.000	11.850	9.000
29	15.700	15.925	103.000	12.000	11.850	9.000
30	15.700	15.925	103.000	12.000	11.850	9.000
AVERAGES FOR MONTH						
June	16.342	16.543	103.000	12.000	11.850	9.548
AVERAGES FOR WEEK						
June						
1	17.325	17.696	103.000	12.000	11.850	11.000
8	17.325	17.500	103.000	12.000	11.850	10.625
15	16.475	16.675	103.000	12.000	11.850	9.417
22	15.800	16.008	103.000	12.000	11.850	9.000
29	15.700	15.925	103.000	12.000	11.850	9.000
CALENDAR WEEK AVERAGES						
June						
4	17.325	17.550	103.000	12.000	11.850	10.850
11	17.075	17.188	103.000	12.000	11.850	10.000
18	16.175	16.258	103.000	12.000	11.850	9.167
25	15.700	15.925	103.000	12.000	11.850	9.000

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

June 1949	Sterling Exchange "Checks"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
1	402.500	71.500	43.500d.	172s. 3d.	$35.00
2	402.750	71.500	43.500d.	172s. 3d	35.00
3	402.750	71.500	43.500d.	172s. 3d	35.00
4	(e)	(e)	(e)	(e)	35.00
6	402.500	71.500	Holiday	Holiday	35.00
7	402.500	71.500	43.500d.	172s. 3d	35.00
8	402.500	71.500	43.500d.	172s. 3d	35.00
9	402.500	71.500	43.500d.	172s. 3d	35.00
10	402.750	71.500	43.500d.	172s. 3d	35.00
11	(e)	(e)	(e)	(e)	35.00
13	402.500	71.500	43.500d.	172s. 3d	35.00
14	402.500	71.500	43.500d.	172s. 3d	35.00
15	402.500	71.500	43.500d.	172s. 3d	35.00
16	402.750	71.500	43.500d.	172s. 3d	35.00
17	402.750	71.500	43.500d.	172s. 3d	35.00
18	(e)	(e)	(e)	(e)	35.00
20	402.500	71.500	43.500d.	172s. 3d	35.00
21	402.500	71.500	43.500d.	172s. 3d	35.00
22	402.500	71.500	43.500d.	172s. 3d	35.00
23	402.500	71.500	43.500d.	172s. 3d	35.00
24	402.500	71.500	43.500d.	172s. 3d	35.00
25	(e)	(e)	(e)	(e)	35.00
27	402.500	71.500	43.500d.	172s. 3d	35.00
28	402.500	71.500	43.500d.	172s. 3d	35.00
29	402.500	71.500	43.500d.	172s. 3d	35.00
30	402.500	71.500	43.500d.	172s. 3d	35.00
AVERAGES FOR MONTH					
June	402.557	71.500	43.500d.	—	35.00
AVERAGES FOR WEEK					
June					
1	402.563	71.500	—	—	
8	402.600	71.500	—	—	
15	402.550	71.500	—	—	
22	402.600	71.500	—	—	
29	402.500	71.500	—	—	

Calendar week averages, New York Silver: June 4th, 71.500; 11th, 71.500; 18th, 71.500; 25th 71.500.

(e) No market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c. per pound, the average differential for delivery charges.

(b) Our export quotation for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c. for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c. to 0.15c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for the Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month; the premium on Special High Grade is 1.

Quotations for lead are for common lead. Corroding lead commands a premium of 10 points.

(c) The daily New York silver quotation reported by Handy & Harman is for silver contained in ores and other unrefined silver-bearing materials, in cents and one-eighth cent fractions per troy ounce. It is determined by Handy & Harman on the basis of actual sales of bar silver .999 fine in amounts of 50,000 ounces or more for nearby delivery at New York, and is usually one-quarter cent below the price paid for such bar silver, this deduction being the allowance for carrying, dilvering, and marketing. In addition to foreign silver, the quotations also apply to domestic and Treasury silver if such silver enters into the New York market.

The Treasury's purchase price of newly mined domestic silver 90.5c. per troy ounce 1000 fine, effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Daily Steel Deliveries to the Mining Industry

Wherever you are, Ryerson trucks are rolling your way every day . . . speeding shipments of the finest quality steel from nearby Ryerson stocks.

Carbon, alloy and stainless analyses in thousands of shapes, sizes and finishes make up this daily stream of steel. In pounds and tons it flows to your industry from the nationwide network of thirteen big Ryerson plants.

This service cuts purchasing time because one call to Ryerson, one order and one invoice quickly covers a whole group of steel requirements. Do you want one piece or a truckload? You get prompt, personal service either way. Do you want your steel sheared, sawed or slit—burned, bent, punched or threaded? You can be sure of getting quick accurate delivery from your nearby Ryerson plant. So call us next time you need steel from stock. We'll get it to you faster because we're coming your way every day.

PRINCIPAL PRODUCTS

BARS—Carbon & alloy, hot rolled & cold finished

STAINLESS—Allegheny metal plates, sheets, bars, etc.

STRUCTURALS—Channels, angles, beams, etc.

PLATES—Sheared & U. M., Inland 4-Way Floor Plate

TUBING—Seamless & welded mechanical & boiler tubes

SHEETS—Hot & cold rolled, many types & coatings

MACHINERY & TOOLS—For metal working

RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI
CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

MARKETS—Trends and Prices

Miscellaneous Metals

(Monthly Averages)

Average prices of miscellaneous metals for May and June:

	May	June
Quicksilver, N. Y., flask	$82.200	$80.269
Antimony (a)	41.730	41.730
Antimony, bulk, Laredo	38.500	38.500
Antimony, in cases, Laredo	39.000	39.000
Antimony, Chinese, (b)	.....	.....
Platinum, oz. troy	72.000	70.154
Cadmium (c)	200.000	200.000
Cadmium (d)	207.500	207.500
Cadmium (e)	215.000	215.000
Aluminum, ingot	17.000	17.000
Magnesium, ingot	20.500	20.500
Nickel	40.000	40.000

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average producers' and platers' quotations. (e) Special shapes sold to platers.

E. & M. J. Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922 - 3 - 4. Copper, Lead, Zinc, Tin, Silver, Nickel, Aluminum)

1939	77.71	1944	88.74
1940	79.22	1945	90.86
1941	83.49	1946	110.06
1942	86.80	1947	149.46
1943	88.74	1948	168.38

	1947	1948	1949
January	140.88	154.20	185.52
February	140.42	155.63	185.75
March	150.71	155.63	179.31
April	153.14	160.67	160.86
May	154.03	161.33	148.05
June	150.05	162.30	131.20
July	148.73	164.55	.....
August	149.35	177.68	.....
September	150.80	178.26	.....
October	151.05	179.58	.....
November	151.92	185.26	.....
December	152.48	185.52	.....

Official London Prices

Since Dec. 18, 1939, the British Ministry of Supply has named maximum delivered prices for the major non-ferrous metals. Delivered prices for consumers in the United Kingdom as of June 30, 1949:

	Per Long Ton £	s.	d.
COPPER:			
Electrolytic, high conductivity	117	10	0
Fire refined, high conductivity	117	10	0
Fire refined, high grade	117	0	0
Fire refined, min. 99.7 percent	116	10	0
Fire refined, min. 99.2 percent	116	0	0
Hot rolled black wire rods	123	10	0
LEAD:			
Soft, foreign, duty paid	82	0	0
Soft, Empire	82	0	0
English, refined	83	10	0
ZINC:			
Foreign (G.o.b.) duty paid	78	0	0
Domestic (G.o.b.)	78	0	0
Prime Western and debased	78	0	0
Refined and electrolytic	78	15	0
Minimum 99.99 percent	80	5	0
TIN:			
Ingot, 99 percent	569	0	0

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York unless otherwise stated

MISCELLANEOUS METALS

(June 30, 1949)

Aluminum, ingot, 99 plus percent, lb. (base price)	17c.
Antimony, spot, lb., 5 tons and up but less than carload, in cases	41.73c.
Bismuth, ton lots, lb.	$2.00
Cadmium, commercial sticks, lb.	$2.00
Calcium, lb., ton lots, 98 percent, cast	$2.05
Chromium, 97 percent grade, lb., contract	$1.07
Cobalt, 97 to 99 percent, per lb.	$1.80
Indium, troy oz.	$2.25
Nickel, electrolytic cathodes, lb., f.o.b. Port Colborne (a)	40c.
Magnesium, 99.8 percent, carloads, lb., producer's plant	20½c.
Palladium, troy oz.	$24.00
Platinum (Official quotation wholesale lots), troy oz.	$69.00
Quicksilver, flask of 76 lbs., 25 flasks or more	$80.00
Selenium, 99.5 percent, lb.	$2.00
Silicon, minimum 97 percent, spot, carloads, lb.	16.50c.
Tellurium, lb.	$1.75 nom.
Thallium, 100 lb. or more, lb.	$15.00
Titanium, 96 to 98 percent, lb.	$5.00@$6.00

(a) Includes U. S. duty.

METALLIC ORES

Beryllium Ore, 10 to 12% BeO, per unit	$25.00@$35.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry	
48% Cr_2O_3, 2.8 to 1 ratio	$34.00@$35.00
48% Cr_2O_3, 3 to 1 ratio	$39.00@$41.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$7.60
Mesabi bessemer	$7.35
Old Range non-bessemer	$7.45
Mesabi, non-bessemer	$7.20
Lead (Galena), 80 percent, Joplin, Mo., ton	$148.65
Manganese Ore — Per long ton unit of Mn basis 48 percent manganese subject to premiums and penalties, 79c. to 81c., c.i.f. U. S. ports. Quoted prices largely nominal.	
Molybdenum Ore, 90%, per lb. of MoS_2 f.o.b. mines	54c.
Tantalite, 60% concentrate, per lb.	$2.00@$2.75
Tungsten Ore, per unit of WO:	
Foreign, 60 percent, duty paid	$23.00@$23.25
Domestic, scheelite, 60 percent and upward	$28.50
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27½c.
Zinc Ore, Prime, 60 percent concentrate, Joplin, Mo., per ton	$50.00

METALLIC COMPOUNDS

Arsenious Oxide (arsenic trioxide) lb., in bbl., carload lots, delivered	6c.
Cobalt Oxide, 70 to 71 percent, lb., ceramic grade	$1.38@$1.40½
Copper Sulphate, 100 lb.	$7.00

ALLOYS

Beryllium Copper, 4 percent Be, per lb. of contained Be	$24.50
Ferrochrome, 65 to 69 percent, per lb. of Cr contained	18.60c.
Ferromanganese, 78 to 82 percent, gross ton, seaboard	$172.00
Ferromolybdenum, 55 to 65 percent Mo, lb. of Mo, contained	$1.10
Ferrosilicon, 50 percent, per lb. of contained Si	11.3c.
Ferrotungsten, 75 to 80 percent, lb. of W contained	$2.25
Ferrovanadium, per lb. of V delivered	$2.90
Silicomanganese, 1½ percent C, per lb. contracts	8.6c.
Spiegeleisen, per long ton, 19@21%	$65.00

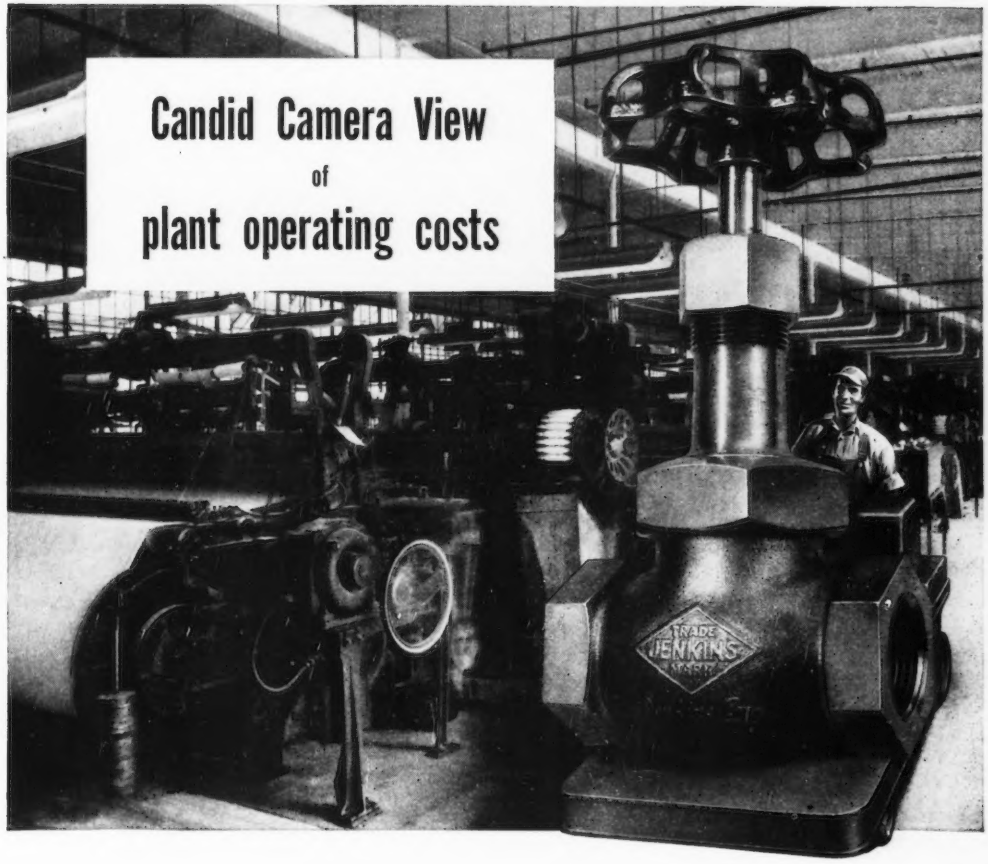
NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U.S. funds), ton:	
Crude No. 1	$960@$1,050
Crude No. 2	$492@$550
Spinning fibers	$232@$475
Shingle fibers	$95.50@$141
Paper stock	$78.50@$88
Waste	$58
Shorts	$27@$52
Vermont, f.o.b. Hyde Park:	
Shingle stock	$97.00@$107.00
Paper stock	$68.50@$85.00
Waste	$51.00
Refuse or shorts	$25.50@$46.50
Barytes, f.o.b. mines:	
Georgia, crude, per long ton	$11.50@$12.00
Missouri, 93 to 94 percent $BaSO_4$, per short ton	$9.00@$9.50
Bauxite, long ton:	
Domestic, crude, 50 to 52 percent (not dried)	$4.50@$5.00
Domestic, chemical, 55 to 58 percent	(a) $8.50@$9.00
Domestic, abrasive, 80 to 84 percent	$17.50@$18.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, airfloated, bulk	$8.50@$9.50
North Carolina, ceramic grade	$18@$22
Feldspar, bulk ton:	
Potash or soda feldspar, 200 mesh	$18.50
Glass spar, white, 20 mesh	$11.75@$12.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois, 70 percent, all rail movement, ton	$37.00
Acid 97% concentrate, bulk, ton	$46.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington	$31
Mica — Domestic f.o.b. mines. Punch, 12 to 22c per lb. according to size and quality. Sheet, clear, 1½ x 2 inch, 70 to 75c.; 2 x 2 inch, $1.10 to $1.20; 2 x 3 inch, $1.40@$1.50; 3 x 3 inch, $1.70@$1.80; 3 x 4 inch, $2.10; 3 x 5 inch, $2.40; 4 x 6 inch, $3.15; 6 x 8 inch, $4.25. Wet ground, very fine, $135@$165 per ton. Bulk sales, dry ground, $40@$80 per ton. Scrap, $21 and up.	
Ocher, Georgia, ton, in sacks	$24.00
Pyrites, Spanish, per long ton unit of S, cif. Atlantic ports	(a) 12@14c.
Sulphur, Texas, mines, long ton	$18.00
Talc, f.o.b. works, ton:	
New York, purified	$18.50@$20.00
Vermont, extra white	$12.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50

(a) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces	$46.00
Steel, f.o.b., Pittsburgh billets, net ton	$52.00
Structural shapes, 100 lb.	$3.25



FOCUSED on operating costs of a textile plant, a truly candid camera would record this view of valves in proper relation, cost-wise, to other equipment. By the simple photo-magic of showing *all* valves in the plant as *one* valve, the picture points up an important fact—that valves, collectively, are a major investment in *any* plant, *any* large building where operation involves fluid control.

IT PAYS MANAGEMENT to keep this fact in mind. With wages and material costs the highest ever, valve maintenance costs must be watched as carefully as operating expense of larger plant units.

EXCESSIVE MAINTENANCE of one inferior valve is insignificant, but multiplied by thousands, it is a serious drain on operating budgets.

JENKINS BROS. helps you meet this problem two ways. First, by building extra endurance into Jenkins Valves, making them the longest-lasting, lowest-upkeep valves that money can buy. Second, with advice from Jenkins Engineers on any question of proper selection, installation, or maintenance.

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"PREVENT VALVE FAILURE" is a 28 page guide to valve economy, fully illustrated, with case histories of valve damage, and recommendations for its prevention by proper selection, installation, inspection, and maintenance. FREE on request. Write JENKINS BROS., 80 White St., New York 13, N. Y.

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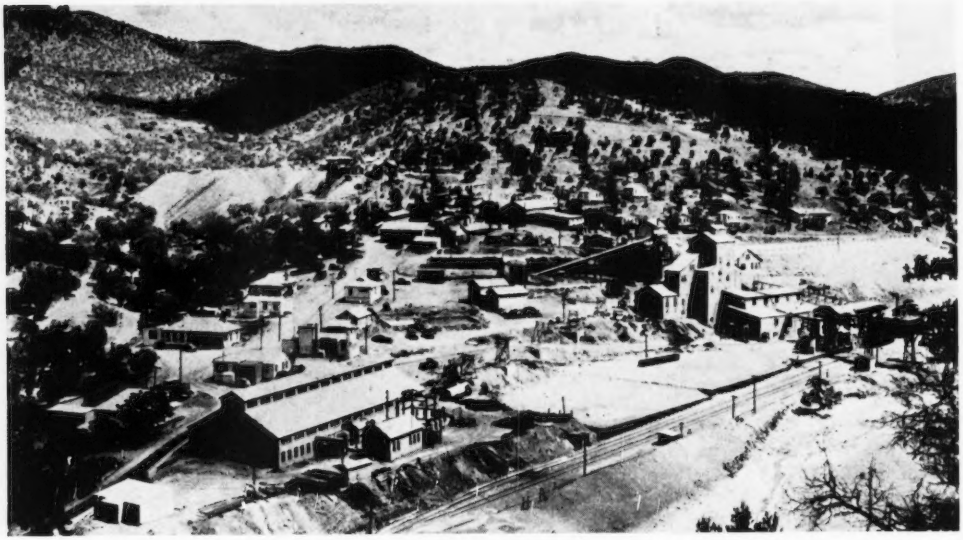
SINCE Jenkins Bros 1864

JENKINS VALVES

Types, Sizes, Pressures, Metals for Every Need

This is the story, in brief, of what mining areas here and abroad are doing to provide future mineral needs—from a three-man prospecting venture to a $90-million project of international scope.



HANOVER MINE AND MILL at Hanover, N. M., is operated by The Empire Zinc Co., subsidiary of The New Jersey Zinc Co. The management has changed from the glory-hole method to open-pit on some orebodies to recover lower grade ores.

NEW MEXICO—In addition to its Carlsbad potash the state boasts substantial production of copper, lead and zinc. Present development programs promise a continued supply of these metals.

Ground Hog mine—In 1928 the American Smelting & Refining Co. acquired part interest in the Ground Hog mine near Vanadium, N.M., and undertook the management of the property. At first, ores (mixed sulphides of lead, zinc and copper with moderate amounts of the precious metals) were produced from veins near the surface, above the 600-ft. level. At this level values pinched out in the veins and the future of the property seemed precarious.

After making geological studies, however, the operators decided to sink a prospect winze to explore the limestone beds thought to occur at greater depths. The winze, put down on an incline for about 1,200 ft., did disclose orebodies and of late years most of the production has come from these lower levels. The new working depths have made necessary the sinking of two shafts to provide adequate extraction openings and better ventilation. One of the shafts has been sunk and is now being equipped. The other has just been started. The two shafts will cost approximately $1,500,000.

Ores from the Ground Hog mine were first treated by other mills of the district on a custom basis, and for the last few years by the Hanover mill, rented from the Black Hawk Cons. Mines Co. A.S. & R. Co. is now building a new million-dollar mill at Deming to treat the Ground Hog, as well as custom, ores.

Empire Zinc Co.—The Hanover mine at Hanover, operated by the Empire Zinc Co., a subsidiary of The New Jersey Zinc Co., lies in what is probably the oldest mining district in the country. There is good evidence to show that native copper was obtained here by early Spanish explorers after Cortez conquered Mexico.

At present zinc and lead are the only metals of importance at the Hanover. Recently some orebodies have been converted from the glory-hole method to open pit using power shovels and trucks. Thus the Empire company can recover lower-grade ore than could economically be mined by underground methods.

Recent improvements at the mill include a new primary jaw crusher, additional grinding capacity, new mechanical flotation cells, and a filter installation replacing settling tanks.

Chino Mines Division, Kennecott Copper Corp., started the Oswaldo shaft in December, 1942, and reached a final depth of 490 ft. Subsequently 13,501 ft. of development headings were driven. To date 232,423 tons of ore has been mined. Operations are on two levels and practically all the ore is mined from simple open stopes as the ground stands well after the ore has been mined.

A new shaft was started about a mile to the east of the old one in April, 1948, and has just reached a depth of 705 ft. It is expected that development work will continue to join up with a cross-country drift from the old shaft and to drift out under some known ore in this area.

Although an appreciable amount of ore has been developed from surface diamond drilling, no estimate can be made until prospecting is done underground.

The Peru Mining Co. will continue operations at Kearney mine of the New Mexico Cons. Mining Co. and will push the development program now under way. The Peru company has curtailed production at the Pewabic mine, but its mill continues at part capacity, treating ore from the Kear-

Heyl & Patterson LOOKS TO THE FUTURE

"All The Way from Design to Erection" is far more than a slogan with *Heyl & Patterson.* It is a plan of operation wherein each essential function from design to successful operation is performed by the one organization.

The many years of successful application of this plan of operation has developed a spirit of teamwork on the part of the *Heyl & Patterson* design, electrical, fabrication, machine shop and erection departments.

This teamwork permits the successful execution of our contracts for Heavy Bulk Materials Handling Equipment on time and on a basis that brings years of satisfaction to our customers.

Mining Companies that are looking to the future are turning more and more to *Heyl & Patterson* not only for Heavy Bulk Materials Handling Equipment but also for Advanced Research that can help the mining industry solve some of the problems connected with the future development of mineral resources.

Ask a Heyl & Patterson Engineer to Consult with You.

Ore Bridges
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Heyl+Patterson, Inc.

"SINCE 1887"

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New Mexico *(Continued)*

ney and Pewabic mines and some custom ore.

The Bayard Unit of the United States Smelting Refining & Mining Co. carried on a vigorous campaign of prospecting and development throughout last year. The company operated five shafts and were deepening one of these, as well as sinking a sixth. The new shaft, not yet completed, is employing mechanical mucking methods for at least a part of the depth.

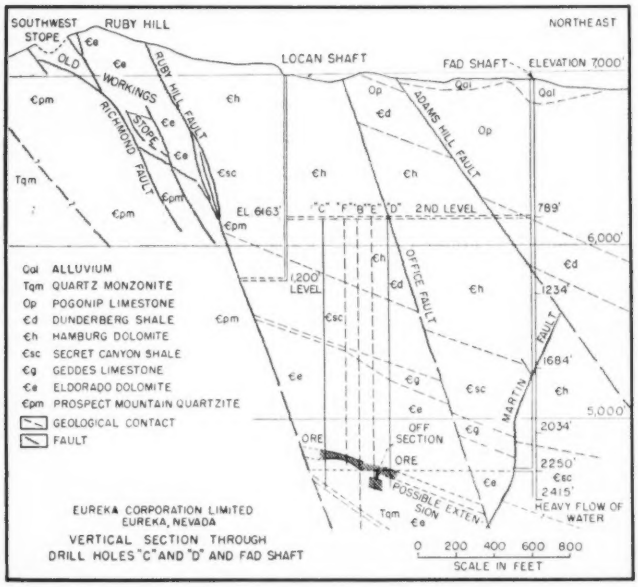
Houston-Thomas—Mathis & Mathis, of Silver City, are operating the Houston-Thomas property, which was a geophysical find. (See E&MJ, March, 1949.) From May 17, 1947, to Jan. 1, 1949, one large orebody produced 21,000 dry tons of zinc-lead sulphide ore. Approximately 2,800 dry tons of similar ore came from smaller outlying orebodies.

According to Robert Mathis, an active core-drilling program is being pursued but to date only smaller outlying pockets of ore have been discovered. One core-drill hole indicated more than 1,000 ft. of diorite porphyry rock beneath the ore. The hole was stopped at 1,100 ft. in diorite porphyry.

Zuni Milling Co.—Developing its No. 21 fluorspar mine near Grants, the Zuni Milling Co. completed two new incline shafts this spring. One is equipped with a belt conveyor, the other with skip and hoist. Ore is being stockpiled while development continues.

Cooperative Mines, Inc., this year acquired the old Star mine in Taos County, as well as six other mica properties in the area. The company planned to produce about 50 tons of marketable scrap mica daily from the Star, milling old dumps and new ore. The mill uses vibrating screens and blower for air separation.

Old Abe mine, of White Oaks mining district, Lincoln County, is being put into operating condition by the newly formed QBQ Co., Inc., in which Donald and Ray Queen, of White Oaks, are associated. A hoist, diesel power plant and other equipment are on order. Operations will commence with ten men. Considerable ore is reported blocked out on the 650-ft. level, containing values in gold and tungsten. If initial development proves satisfactory the company plans to install a mill to concentrate low-grade ores.



EUREKA CORPORATION LIMITED
EUREKA, NEVADA
VERTICAL SECTION THROUGH
DRILL HOLES "C" AND "D" AND FAD SHAFT

NEVADA—Getchell Mine will put enlarged cyanide plant into operation, based on two years' pilot-mill experiments. Newmont's mill at Goldfield is preparing to accept custom ore.

Fad Shaft—Continued efforts by Eureka Corporation, Ltd., last year to unwater the Fad shaft at Eureka ended only in further flooding below the fifth level. The company therefore decided in December to halt all pumping and make a thorough survey, aided by the best experts available.

Late in April, G. W. Mitchell, general manager, announced to stockholders that plans were being developed for attacking the water problem, but that at least two years would be required before unwatering could be attempted again.

"It seems quite likely that pumping tests of various kinds will be necessary in an effort to determine the source of the water and the possible ultimate volume which may be expected. These tests may indicate that it is feasible to form a barrier of grout or other material at the points of water entry on the margins of the fault block in which the ore occurs. (*See above section.*) It seems the major volume of water is not coming from the area we wish to drain."

The management believes the necessary work can be accomplished to solve the water problem without addition to the present diesel electric power plant. However, a source of cheaper power will be necessary and present investigations indicate that a fair sized block of power can be obtained from Hoover Dam.

Copper Canyon Mining Co. expected to attain capacity mill feed of 350 tons per day this spring. Tonnage has been built up chiefly from the Hornfels lead-zinc-silver orebody which was opened on the new 700-ft. level of the Julie shaft. Operators have been diamond drilling on this level to ascertain the lateral extent of the orebody, which has produced a concentrate of substantially higher value than did the copper-gold product of upper levels.

Constant Minerals Separation Process, Inc., has set up equipment to work gold-bearing gravel on a large scale in the Rosebud district.

Getchell Mine, Inc., has enlarged its cyanide plant in the Potosi district, Humboldt County, from 1,000 to 1,500-ton capacity and expects to be operating by August. The worst winter in many years delayed plant completion by several months.

Metallurgy, following two years of experiment with a 100 to 200-ton pilot plant, will differ widely from earlier practice. Ore roasting, formerly in two oil-fired 260x7½-ft. rotary furnaces, is to be eliminated. Primary flotation will remove the refractory arsenical pyrite, of which there is less in the deep-level product than near the surface.

When the mill gets underway, the management plans to take 1,200 to 1,300 tons of ore per day from surface pits and only 200 or 300 tons from underground as a sweetener.

Nevada Uranium Production Co. installed a Worthington compressor and

A thousand times the force of gravity

Yanks the slimes out of your flotation feeds

The Bird Centrifugal Classifier effects clean, sharp cuts as fine as one micron if desired.

★ ★ ★

Chemical dispersion is generally unnecessary; cell capacity is increased; reagent cost is reduced.

★ ★ ★

Slurries at ball mill consistency are handled without dilution in many cases.

★ ★ ★

The Bird Classifier turns out as much as a ton or more a minute and requires no more attention than a pump.

Let us send you the whole story.

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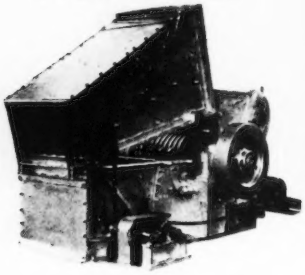
DIXIE NON-CLOG HAMMERMILLS

for *GREATER* production at *LESS* cost.

The one and only Dixie NON-CLOG Moving Breaker Plate Hammermill* sets a new standard of crushing efficiency in the reduction of wet, sticky materials.

If you have wet, sticky material to crush, if you have difficulty in reaching and maintaining desired production, if you have any crushing problem at all, it will pay you to take advantage of this vastly improved crushing principle.

*U. S. Patents Granted & Pending.



No. 2424 Dixie Premier Jr. NON-CLOG Hammermill with Moving Back End (shown with cover partly open). In this mill a moving belt keeps material "on the go"... prevents "traffic jams"... assures fully productive, continuous crushing.

Dixie Non-Clog Hammermills are made in sizes ranging from 24" up to 96" in dia.

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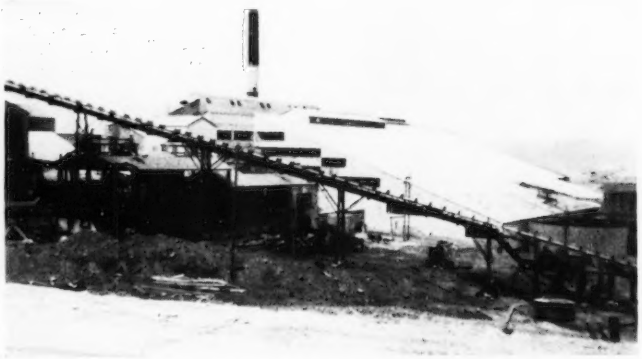
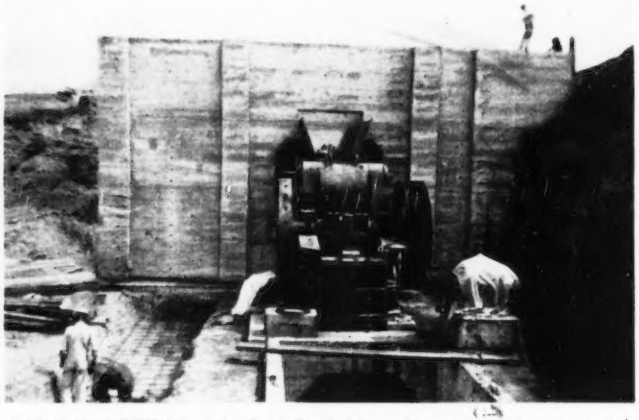


GETCHELL CYANIDE PLANT in the Potosi district of Nevada is ready to operate at enlarged capacity of 1500 tons a day. Flowsheet was changed after experimenting with a pilot mill for two years.



THIS 42x48-IN CRUSHER at the Getchell mill delivers the ore to a 36-in. conveyor belt which is 500 ft. long.

Nevada *(Continued)*

other equipment at its leased Rainbow mine at Round Mountain in March. Operators were to extend the main 340-ft. tunnel, largely in uranium-bearing ore, and to sink winzes where the highest measure of radioactivity is indicated.

Newmont Mining Corp. put its flotation-cyanide mill at Goldfield in operation late in March. Newmont officials expected the plant would be accepting custom ore by July. The mill will work up gradually to its capacity of 100 tons per day.

Tonopah Divide—Tonopah men have leased and are reopening the formerly productive property of the Tonopah Divide Mining Co. in the Divide district. The new operators, reconditioning the main shaft, reported much of shipping grade between the 300 and 1,000-ft. levels. They hope to market their product at the Newmont mill at Goldfield.

CALIFORNIA—The strongest growth shown in non-metallics; gold output has increased.

Mining in California shows a mixed trend. Construction materials such as rock, sand, gravel and limestone continue in great demand, and many new plants have been constructed recently to supply the large and growing population centers of the state.

Pacific Coast Aggregates has built a $2-million plant at Elliott, Alameda County. Cement, clay, gypsum and talc also continue in good demand, and pumice and perlite operations are expanding. Riverside Cement Co. has expanded production facilities, as has U. S. Gypsum Co. operating in Imperial and Riverside Counties. Owens-Illinois Glass Co. constructed a new sand treatment plant at its Corona silica sand property involving an expenditure of nearly $1 million.

Eagle Mountain mine—The opening of Henry Kaiser's iron mine has given encouragement to this branch of the industry recently. Going into full production late last year, the mine now furnishes about 90% of the raw materials for the blast furnace and steel plant at Fontana.

Yuba Consolidated—In spite of high cost of labor and supplies, and high taxes in the face of a fixed price, gold output in the state has increased from an all-time low in 1944 of $4,108,055 to an estimated $14,647,150 (418,490 oz.) in 1948. The greater part of this production was by bucketline dredges of the Yuba Consolidated, Natomas Co., Snelling Gold Dredging, and others.

Central Eureka Mining Co.'s lode property at Sutter Creek is an admirable example of a return to production after the lifting of L-208. Rehabilitated at great cost, and with discouraging setbacks including slow delivery of equipment, the mine and mill in March reached their scheduled rate of 150 tons a day.

Idaho-Maryland—Principal gold producers in the Grass Valley-Nevada City area are the Idaho Maryland mines and Empire Star. Idaho Maryland Mines Corp. is now developing the new vein found on the 2,700-ft. level of the Idaho mine. Other lode mines active include the Ancho-Erie, Sixteen-to-One, Mt. Gaines and Belden. The property of Calaveras Central Gold Mining Co., a drift gravel mine near Angels Camp, Calaveras County, is being equipped for early production.

California Silver Corp. is erecting a 50-ton amalgamation and flotation plant at Silver Lake north of Baker. The new mill is to process ore from the company's Silver Hill mine near Riggs.

Darwin mine—Lead mining was principally confined to the Darwin and Tecopa areas of Inyo County where Anaconda Copper Mining Co. continued to improve plant facilities at the former mine and push development work at the Tecopa holdings. In the Shasta County copper-zinc belt, Coronado Copper & Zinc Co. reopened the old Afterthought mine and constructed a 100-ton flotation mill to treat the complex copper-lead-zinc ore. Mountain Copper Co., Ltd., continues as the principal producer of pyrites.

U.S. Vanadium—Outstanding development in the tungsten industry is the expansion program nearing completion at the Pine Creek mine of U. S. Vanadium Corp. near Bishop, Inyo County. This includes widening the new Zero tunnel, now 7,300 ft. long, to 9x12 ft.; installing a new coarse-crushing plant, electric haulage system in Zero tunnel, repair shop, drill bit sharpening shop, timber-framing shed, and combination office-dry house. The buildings are at the portal of the Zero tunnel.

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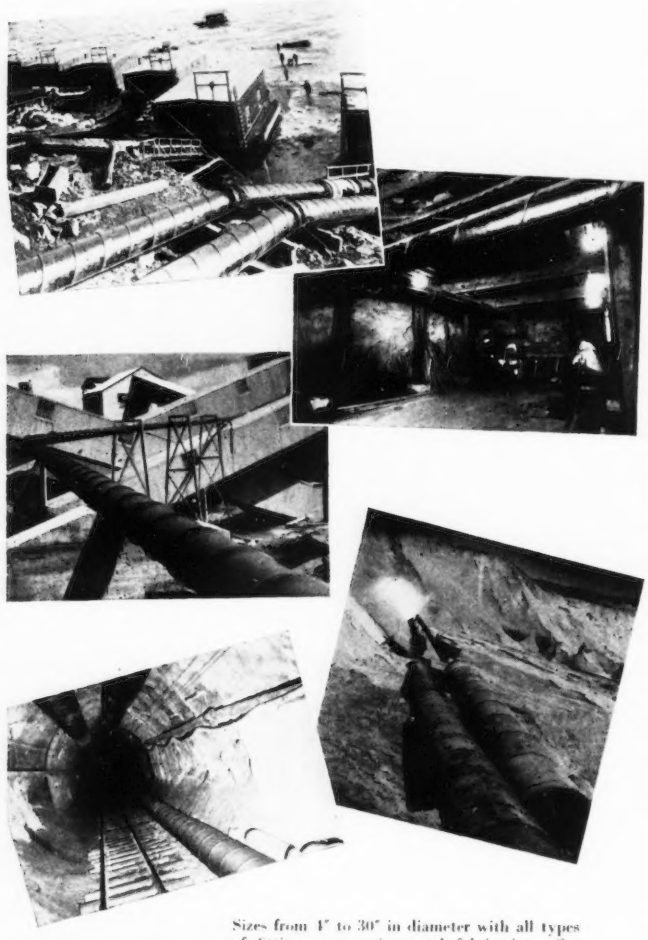

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UTAH—Important find in the state recently was lead-zinc-silver ore at the Ontario mine.

Vanadium Corporation of America has built a $50,000 mill to treat complex copper-uranium ores at the mouth of White Canyon, San Juan County. Because of primitive roads and very unfavorable weather conditions early this year, equipment for the mill was ferried across the Colorado River.

Park Utah Consolidated Mines Co. uncovered an important orebody below the 1,500-ft. level in the Ontario mine, Park City, in March. Miners cut into ore running approximately 38% lead, 16% zinc and 12 oz. silver to the ton. Paul H. Hunt, manager, said the new orebody is somewhat similar to that found on the 1,600-ft. level during exploration work last year. The company is trying to establish whether there is a connection, anticlinal or otherwise, between the two discoveries of ore.

American Gilsonite Co. plans to dissolve gilsonite in Rangely crude oil and pump it through the Salt Lake City-Rangely pipeline to the Salt Lake Refining Co. plant. An "oversized pilot plant" costing $200,000 to $300,000 is under construction at Bonanza, Colo. Gilsonite equivalent to 100 to 600 barrels of oil a day will be placed in the pipeline, and the refinery will treat the solution by distillation.

The pilot operation will consist of a screening and pulverizing plant where the gilsonite will be processed to pass a 100-mesh screen. Crude oil from Rangely which is under 1,200-lb. pressure in the pipeline will be taken from the line, reduced to atmospheric pressure and heated. The powdered gilsonite will be introduced into the heated oil and the solution pumped to Salt Lake City, where the new refinery owned by Standard Oil Co. of California is operating.

American Gilsonite Co., owned jointly by Barber Oil Co. of New York and Standard Oil Co. of California, also plans to mine gilsonite deposits in open cut and develop a big-volume, low-cost source.

The Garfield Chemical Co., owned by American Smelting & Refining Co. and Kennecott Copper Corp., has under way a $6,250,000 program to increase sulphuric acid production and help eliminate smelter smoke problems. Construction includes installation of a Cottrell treater and a flue. Fumes and gases from the smelter will be passed through the precipitator to remove the solids. The sulphur dioxide in the gases will be utilized for the production of sulphuric acid.

Any sulphur gases which cannot be converted into acid will be discharged at high temperatures from taller stacks in the canyon behind the smelter.

ARIZONA—Uranium projects in the state are now producing 200 tons of ore daily.

Arizona is producing uranium ore at the rate of 200 tons a day, making the state second in the nation only to Colorado. This fact was a surprise even to the Arizona Department of Mineral Resources, which had been unaware of some uranium projects in the northern sectors.

Vanadium Corporation of America—Charles H. Dunning, director of that department, made a field trip recently and reported the Vanadium Corporation of America has open-pit mines on the Navajo Indian reservation at points 23 miles south of Mexican Hat, Utah; three miles west of Carrizo; 12 miles north of Carrizo and five miles north of Red Rock. All are near the Arizona-New Mexico border.

The Vanadian corporation has selected 30 other mine sites and expects to do further exploration on the Navajo reservation. Ten percent of the income derived from sale of uranium ore is being returned to the Navajo Tribal Council. On a basis of 200 tons of ore daily, the Indians receive $1,000 a day. (See page 136.)

The Bonanza Mining Co. copper mine in Yuma County was to begin producing last month, shipping to the Magma smelter at Superior. The shaft is being continued from the 280 to 300-ft. level, where drifts and stoping will begin. Ore at the 280-ft. level gave an average assay of $38 per ton.

The Bonanza company expects investment on development will come to $200,000, and a reduction plant will cost another $100,000.

Antlers mine—At the Antlers mine, of Arizona Antlers Corp., a reserve of copper-zinc ore has been developed. The recently formed Yucca Mining and Milling Co. has taken a lease and option on the property and has completed buildings for a 150-ton concentrator.

COLORADO—The new Carlton mill will solve a big haulage problem for producers.

The Carlton group of companies is going deep for new production in the Cripple Creek gold mining district. This group includes the Golden Cycle Corp., Cresson Cons. Mining and Milling Co. and United Gold Mines.

Golden Cycle completed a six-mile drainage tunnel, and laterals are being driven from the tunnel, at 3,000-ft. depth, to the Cresson and Vindicator mines. The laterals, which will drain the eastern end, or possibly all, of the Cripple Creek district, are expected to extend the life of the gold area by some 25 years.

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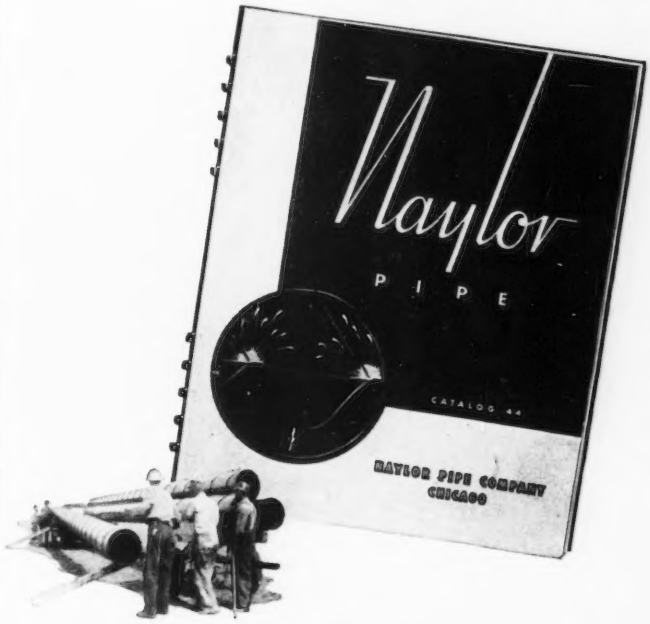

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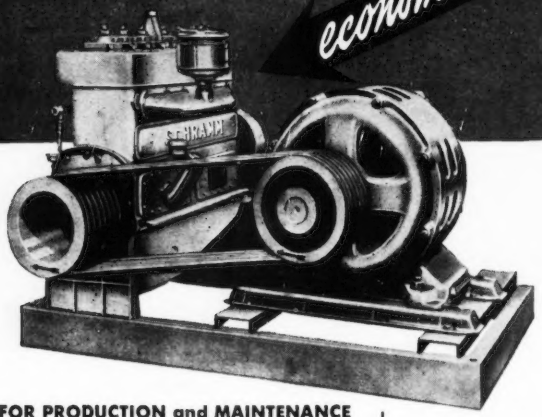

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THE EAGLE MINE at Gilman, Colo., and surrounding territory. The New Jersey Zinc Co., operators, have recently brought the capacity of the underground mill from 750 to 1200 tons a day.

Colorado *(Continued)*

The richness of the Cripple Creek ore continues down to the 3,000-ft. depth of the drainage tunnel and probably deeper. One 35-ton car shipped from the 27th and 28th levels of the Cresson mine last January averaged 16.28 oz. of gold per ton, according to the manager. On the same day a 20-ton car of coarse rock carried about 8 oz. of gold per ton.

The new Carlton mill is now under construction at Elkton to replace the Golden Cycle mill at Colorado Springs. The new location in the heart of the mining district does away with a 75-mile haul formerly required from mine to mill.

The old steam hoist at the Cresson mine made way for a modern electric hoist in February. The new hoist, purchased by Cresson Cons. from a California mine, was built for a 5,000-ft. shaft and has a speed of 1,400 fpm. When the tunnel lateral is completed to a point below the Cresson shaft, the new completed shaft will be 3,000 ft. from collar to bottom level.

Ibex-Sunday project—For many years geologists familiar with Leadville have recognized speculative ore possibilities in a down-faulted geological unit in the southeast corner of the district near the Breece Hill stock. This hypothesis assumes the presence of Leadville blue limestone in the area. However, crosscutting stocks and dikes make the extent of the lime beds highly uncertain, and there are a number of other factors adverse to the exploration of the area. These conditions deferred active interest by any mining group until the American Smelting and Refining Co. decided to

tackle the project during the acute metal shortage of the war years.

The objective of exploration is to determine whether or not ore is present in commercial quantity in the Leadville blue limestone in the fault-block area. Unfortunately, this horizon is not only below the water table, but also more than 2,000 ft. below the surface in places. Obviously, in terms of the size and probable value of orebodies expected, drilling from surface would be too expensive. Moreover, direct underground exploration would require a gamble of several million dollars, none of which would be salvaged if no ore were found. Therefore, a prospecting level was opened up by the smelting company at about 1,000 ft. below the surface, entirely for the purpose of providing more convenient drill sites.

It is reported that over $500,000 has been so expended to date, but much more work must be done before the worth of this project will be demonstrated. Then, if results be finally encouraging, a vigorous preparation program involving large expenditures over a period of several years will be required to carry the project to the production stage.

The Eagle mine at Gilman, 30 miles west of the Continental Divide, operated by the Empire Zinc division of the New Jersey Zinc Co., has developed into an important zinc producer, with substantial quantities of lead, silver and copper.

The company recently erected a new fireproof headframe and surface buildings. The shaft collar has been concreted and, in the vicinity of the shaft, timber has been replaced by steel at the levels. A new underground grinding plant will prepare slimes for filling fire areas.

Improvements and additions to the underground mill have increased the milling capacity from 750 tons to 1,200 tons per day.

Aspen Mining Co.—To explore zinc and lead properties in the Aspen district, where an extension of one of the old bonanza orebodies has been discovered, the Aspen Mining Co. was formed recently. The Anaconda Copper Mining Co.; Humphreys Corp. of Denver; and J. W. Patterson, a Salt Lake City metallurgist, are the incorporators and are reported to have leased most of the dormant properties in the area. About a dozen men went to work at the old Smuggler mine this spring.

Southwest Metals Mining Co.—At the Michael Breen mine at Ouray, Southwest Metals Mining Co. completed a 260-ft. three-compartment service raise and ore pass this spring which connected Monarch No. 1 and Monarch No. 2 levels. A new level, Monarch No. 3, was driven on the orebody.

Telluride Mines, Inc., is driving a tunnel from its mill to the Pandora and Smuggler Union veins at an elevation of 9,070 ft. above sea level, or

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Colorado (*Continued*)

1,100 ft. below the lowest present workings. The adit will develop at considerable depth veins that outcrop high above timberline in the San Juan mountains, as well as furnishing transportation for ore to the mill. Eventually Telluride will send all ore through the tunnel and abandon the aerial tramway that has served this property for many years.

KENTUCKY-ILLINOIS—This district produced most of the domestic fluorspar in 1948.

Modern industrialization depends heavily upon fluorspar. Steel, aluminum, ceramics, refrigeration, and even the production of uranium 235 make use of the various properties of fluorine compounds, which in one form may be extremely active and corrosive, and in another form exceptionally inert and stable.

Hence domestic fluorspar production has increased markedly to parallel recent industrial expansion, rising from an average of about 120,000 tons per year from 1930 to 1940, to 331,392 tons in 1948, a peace-time record. Of the 1948 production, 257,450 tons, or nearly 78%, came from the Kentucky-Illinois area, where operators are improving and extending mining and milling plants to keep abreast of the growing national demand for fluorspar.

The widespread adoption of the Heavy Media separation process is noticeable. Eight mining companies in the district have recently installed such units: Rosiclare Lead & Fluorspar Mining Co., Alcoa Mining Co., Alco Lead Co. and Crystal Fluorspar Co. in the Illinois area; and Kentucky Fluorspar Co., Davenport Mines, Inc., Inland Steel Co. and Fluorspar Corp. in Kentucky.

Alcoa Mining Co., fluorspar division, will soon construct a 100-ton flotation mill at its Hutson mine, in Livingston County, Ky. The recently discovered orebody at the mine is expected to average 28% zinc.

Alco Lead Co., operating the Patrick mine in Hardin County, Ill., the only open-pit operation in the district, started its new gravity mill and made its first shipment in March. The mill, handling a lead-zinc carbonate, consists of the Heavy Media separation unit and four Deister and three Shackleford tables. Mill feed averages 300 tons daily, and the average concentrate is 50% lead and 6% zinc. Flotation sizes are being impounded for subsequent retreatment. Soil auger tests around the Patrick have shown deposits to be general.

Former mining consisted largely of high-grade, low-volume handwork.

Hutson mine—Several new shafts are

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being sunk in the district. At Alcoa's Hutson mine, the shaft has advanced 115 ft. of the scheduled 510-ft. depth. Old workings have been pumped out, and a crosscut will be driven from the old to the new shaft. A standby power plant is in operation. New facilities including the hoist-house and powerhouse, change room and blacksmith shop, and storehouse and office building have been completed, as well as a new access road to the mine from Green's Ferry Road, Livingston County route. Power lines are being erected.

Ozark-Mahoning Co. has completed a 400-ft. shaft on its Green property, fluorspar-zinc producer, in the Cave-in-Rock, Ill., section. On the Kentucky side, Ozark-Mahoning has deepened the Commodore shaft, operated under lease from Moody and Crider, from 100 ft. to 250 ft., and it is now in production.

Crystal Fluorspar Co.—Also in the Cave-in-Rock area, the Crystal Fluorspar Co. is engaged in sinking a new 260-ft. shaft, No. 9, and Minerva Oil Co. has begun construction of a 580-ft. escape and service shaft which will be completed in early fall. Minerva also is doing extension drilling in the Potosi, Mo., lead and zinc area with five churn-drill rigs in operation.

The Pigmy Corp., subsidiary of the Rosiclare Lead & Fluorspar Mining Co., is sinking the Hoptown shaft at the Pigmy fluorspar mine near Mexico, Ky. Development work is to proceed on an orebody indicated by diamond drilling. The company also is deepening the Railroad shaft.

The PMT Co., which sub-leased acreage in Pope County, Ill., from the Hicks Creek Mining Corp., has sunk two new shafts, 140 ft. and 125 ft., respectively.

Rosiclare Lead & Fluorspar Co. has completed installation of an 1,800-gpm., 660-ft. head, deep well type pump at the Rosiclare shaft. A new ball mill and new ore-feeding facilities are on order. Two Denver Mineral jigs have been added in the fine-ore treatment section for the recovery of lead concentrate from certain ores. It is proving successful in recovering minor fractions in the form of high-grade concentrates. The flowsheet of the flotation plant has been altered and simplified with a view to increasing capacity.

Ozark-Mahoning—At Ozark-Mahoning's Rosiclare mill, additional equipment is being installed to re-grind and re-handle middlings from the spar circuits. The project will be completed within the next few months.

Inland Steel Co. is installing a primary crusher and conveyor in its Keystone mill and is building an electrical shop. The company recently set up conveyor barge-loading equipment on the Kentucky side of the Ohio River, opposite Elizabethtown, Ill., for shipment of the Keystone ore.

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Kentucky-Illinois *(Continued)*

U. S. Coal & Coke Co., fluorspar division, at Mexico, Ky., has completed a geological survey of its "Big Four" property leases, comprising 1,000 acres, and plans immediate exploration drilling.

C. and L. Fluorspar Co., of Marion, Ky., has resumed operation of its Marion flotation mill, purchased from Minerals Flotation Corp. The company also acquired two properties, the New York-Kentucky and the Hewitt mines in Caldwell County.

IRON COUNTRY — Mather "B" shaft is the outstanding underground development.

During the postwar years there has been an increasing tendency in the Iron Country to convert underground mines to open-pit operation. Among recent "converts" are the Monroe, Gilbert, Schley and Miller-Mohawk, with the Bruce a likelihood for the near future.

South Agnew—The most conspicuous example is the South Agnew at Hibbing, Minn., from which about 2,500,000 tons was mined underground before Butler Brothers acquired the property. It is now well on its way toward becoming a steady open-pit producer, with 500,000 to 600,000 tons scheduled for 1949. About 20,000,000 cu. yd. of stripping will eventually be moved at the property.

The dragline-belt conveyor equipment which is so efficiently moving the South Agnew stripping is increasing appreciably the practicable ratio of overburden to ore. No cost of dirt moving at this mine has been made public, but it is probably not more than half of the cost by standard shovel and locomotive haulage that was used in estimates of a few years ago.

Wanless-Woodbridge — Included in Cleveland-Cliffs Iron Co.'s winter stripping program were the Wanless and Woodbridge mines at Buhl, Minn. Both have been idle for many years but are expected to produce this season.

Schley mine at Gilbert, Minn., on the eastern Mesabi, had been inactive since 1945 until it was taken over recently by Inter-State Iron Co. That company expects to remove 900,000 cu. yd. of stripping before the 1950 shipping season, using a 3-cu. yd. electric shovel and five 15-ton trucks. A washing plant, loading pocket, office, garage and shop will be built.

Gilbert and Canton mines—Last summer Oliver Iron Mining Co. began unwatering the Gilbert mine, which is said to contain more than 10 million tons of ore. Late this spring the first shipments of ore in recent years were made from the Gilbert and from the

Canton, another Eastern Mesabi property.

The Champion mine at Beacon was unwatered last winter, and the first ore produced there since 1910 was hoisted on March 8. North Range Mining Co., operating the mine for U.S. Steel Co., owner, expects to produce 100,000 tons a year. Total 1949 production was to go to U.S. Steel.

Mather "B" shaft—At Mather "B" shaft of the Cleveland-Cliffs Iron Co., Negaunee, good progress is being made on installation of surface equipment. In the new brick engine house west of the shaft a Nordberg man hoist was completed early in June, with the exception of electrical equipment. Concrete was being poured for the ore hoist of the same make. Both of these hoists have 12-ft. diameter drums, operating at 2,000 fpm. on the man unit and 2,400 fpm. on the ore machine. Twelve-ton skips in balance will be used with one drum equipped with clutch. The hoists are designed for a total depth of 4,500 ft. One 2,700-cfm. I-R compressor was installed and the second to be completed in the near future. The McDowell Co., Cleveland, was erecting the steel headframe and expected to have it completed in July.

A contract of close to a million dollars was recently awarded to A. H. Proksch Co. to erect the brick surface buildings consisting of office, change house, shops and heating plant. The shaft was down 2,700 ft. last month and should be completed in another two months.

Vicar mine — With ore shipments scheduled for the spring of 1950, Jones & Laughlin's Vicar mine at Wakefield is fast getting ready for production. The shaft was completed late last year. In February Worden Allen Co. finished erection of the permanent 57-ft. headframe. Underground, loading pockets and spillage pocket have been built, as well as a tunnel connecting the shaft with change house. The change house and first-aid room were reported nearly complete in May. A 24-in. pan conveyor was installed recently in the headframe to handle rock produced in underground development.

Pioneer mine—Oliver Iron Mining Co., developing its Pioneer mine, is deepening the "A" and "B" shafts to open the 16th level. "A" shaft is used for handling men, supplies and rock and is to be sunk to 1,516 ft. The inclined "B" shaft, used for hoisting ore, is to go to 1,647 ft. In April it was estimated that the shaft sinking and the necessary haulage drifts and crosscuts to complete the development program would take about 30 months.

Montreal Mining Co., operated by Oglebay Norton & Co., plans to sink a 1,700-ft. incline below the 35th level of the No. 5 shaft at Hurley, Wis. The company will install hoisting equipment on the 35th level, and transfer ore here for hoisting to the surface.

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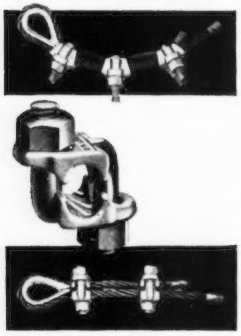

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Iron Country *(Continued)*

Inland Steel Co.'s new ore carrier, the "Wilfred Sykes," was launched June 28, at the Lorain, Ohio, yard of the designer and builder, American Ship Building Co. The carrier will have an overall length of 678 ft., a molded breadth of 70 ft., and a molded depth of 37 ft. With a speed of 16 mph. loaded and 17¼ mph. light, it is expected to increase the number of round trips possible between Indiana Harbor and Superior, Minn., from 34 to 44 a season. The "Wilfred Sykes" is to be the largest and fastest ore carrier on the Great Lakes, and will go into service for the 1950 navigation season.

MICHIGAN — Calumet and Hecla is now refining slag charges to billet specifications.

Calumet & Hecla—The sudden drop in the copper market caused Calumet & Hecla to suspend copper production temporarily on May 1. During all of 1949 the company has been stressing increasingly development of byproducts and scrap reclamation.

Calumet & Hecla's foundry was modernized early in the year to supply the company's needs and do custom work.

In March the Prozite Company was organized by Calumet & Hecla and Poor & Co., of Chicago, to make buffing and polishing compounds from conglomerate copper sands. The necessary equipment for the project was to be installed in the Calumet stamp mill at Lake Linden. Poor & Co. was to market the products.

Other byproducts of the C. & H. company are copper hydrate, copper oxychloride and copper oxide, made in cooperation with Lake Chemical Co.

As a result of improvement in the soda-ash process for arsenic removal, slag charges in the smelter at Hubbell have been refined to billet specifications without dilution. Never before had copper from a slag charge been refined to the purity required for direct casting into commercial shapes. The improved process will give C. & H. more copper per month from slag and will get it to market faster, as it is going directly into a saleable product. The high cost of handling, storing, remelting and recasting the low-grade ingots will be eliminated.

MONTANA — Anaconda will spend about $1,800,000 improving reduction works.

Anaconda Copper Mining Co., at its Anaconda, Mont., reduction plant is producing ferro-manganese. The first of a series of electric furnaces was started on Feb. 5 and two more at the

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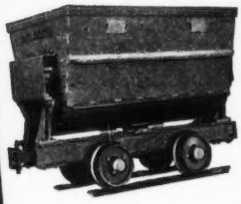

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end of March. The fourth new furnace is scheduled to be completed by August and the production of standard grade ferro-manganese should total around 1,792 tons a month.

Anaconda has been mining relatively low-grade manganese carbonate ore at Butte and producing manganese oxide nodules averaging 60% Mn. Additional iron required in making ferro-manganese is supplied from iron ore, of which approximately 280 tons a month will be consumed on a four-furnace basis.

The Anaconda company plans to spend approximately $1,800,000 for additional facilities at its Great Falls Reduction Works. This includes a new department for casting copper billets, and a complete unit to be added to the present eight units of the zinc processing department. An employees' clubhouse will cost about $200,000. New installations and buildings are to be completed by July 1, 1950.

Olamont Mining Co. has taken a bond and lease on the property of Ermont Mines, Inc., near Dillon, and is preparing to resume mining. The property has not been worked since 1942, but is fully equipped and has a 100-ton counter-current cyanide plant.

Ruby Gulch Mining Co. recently encountered a new body of high-grade gold ore at its Zortman property. The company is now shipping ores assaying from $100 to $300 per ton and cyaniding ores assaying less than $100.

U.S. Gold Corp. is ready to put its mill at Sheridan in condition to handle 250 tons a day. Its properties are in Bear Gulch, Madison County. This spring plans were to drive the 2,800-ft. crosscut an additional 750 ft. to bring it under the gold orebodies encountered in the upper levels.

U. S. Grant Mining Co., also in Madison County, operates several properties near Virginia City. The company expects to build a 250-ton flotation mill to treat its gold ore. Main feed will come from the Easton-Pacific property.

Alps Mining and Milling Co. is installing a 150-ton flotation plant at Harvey Creek, and Morning Glory Mines has a new 150-ton flotation plant completed at Yak.

Mineral King Mining Co. has done considerable development work both underground and with a bulldozer on the surface at its Saltese property in Mineral County. Low-grade silver-lead ore was encountered early this year. Operators are now driving a crosscut tunnel and drifts. Other notable development is underway at Marysville, where Carbonate Mines, Inc., is driving a 750-ft. crosscut tunnel to tap ores at depth.

Zonolite Co. at Libby, whose vermiculite output increased from 20,000 tons in 1940 to 140,000 last year, is installing additional equipment.

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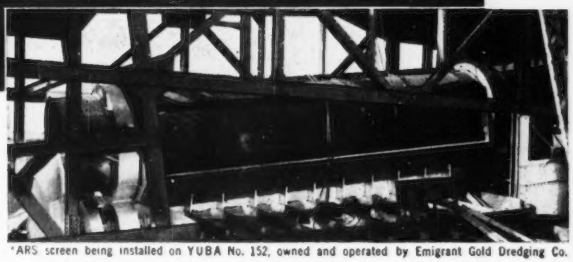

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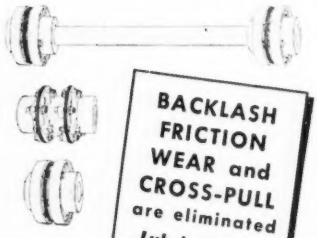

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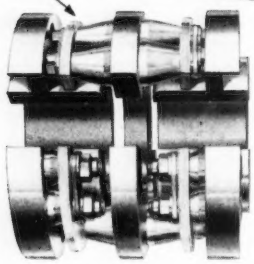

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WASHINGTON — Several companies show increased interest in Stevens County mines.

Columbia Gypsum Products, Inc., one of the new industries in eastern Washington, expects to be ready to sell Washington, Idaho and Oregon residents agricultural gypsum about Sept. 1, according to H. A. Andrews, plant manager. Construction of $200,000 grinding and plaster plant was authorized in May. This 120-ft. unit is to adjoin the present 120-ft. structure in the Spokane Valley. The completed plant is to have a capacity of 500 tons per day. The company's gypsum comes from a deposit at Windermere, B.C.

Goldfield Consolidated—Since Goldfield Consolidated Mines Co., of Reno, Nev., became interested in properties in Stevens County a number of other companies have stepped up their work and new companies are entering the field. Goldfield has increased its mill capacity 50% since January at its Deep Creek zinc-lead mine. It reported ore sales of $862,568 from the mines last year.

A recent problem there has been the heavy flow of water in the underground workings. Cement has been used to block off the water and results look promising.

Mines Management, Inc., one of the newer companies active in Stevens County, is developing the Advance lead-zinc mine near Northport and the Iroquois mine near Leadpoint, jointly with Silver Dollar Mining Co.

G. O. Dunlop, who is president of both companies, announced recently that drifts totaling 270 ft. at the Iroquois have shown continuous ore. Diamond drilling totaling 3,500 ft. had indicated over 1 million tons of commercial ore. Two shifts are drifting east and west along the footwall of the ore zone, averaging about seven feet per shift. Plans are to drive more than 300 ft. in both directions. Crosscuts will be driven 150 ft. apart, three 200-ft. raises will be made and diamond drilling will continue. Mr. Dunlop announced to stockholders of the Silver Dollar that plans were eventually to construct a mill at the Iroquois.

At the Advance mine where 20,000 tons of ore have been blocked out, a crosscut tunnel has been driven 160 ft. and a new vein has been uncovered with bulldozers. The Hubbard mine, ten miles west of Northport, was acquired by Mines Management and diamond drilling was scheduled to start there this spring.

Consolidated Speculator Corp. is developing the lead-zinc-silver mine, known as the Lucille, near Leadpoint.

Gladstone Mountain Mining Co. has been shipping lead concentrates from the Gladstone mine in Stevens County.

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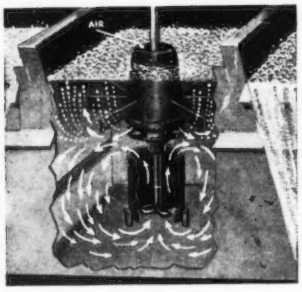

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BOOTH ENGINEERS
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SALT LAKE CITY, UTAH

Old Dominion—Ira M. Hunley and Earl B. Gibbs, who have been operating the Bonanza mine north of Colville, said to be the largest lead mine in the State, have acquired the Dominion Silver-Lead Mining Co.'s property in Stevens County, under option, and are doing exploration and development work at the Old Dominion.

Admiral Consolidated Mining Co. plans to increase production at its zinc-lead property near Leadpoint this year. According to Mrs. J. Richard Brown, secretary-treasurer, about 4,000 tons of ore are blocked out ready to be processed at the 75-ton flotation mill. Other work will consist of extending the main tunnel and also sinking on an 18-in. vein.

Northwest Magnesite Co., at Chewelah, has replaced a wooden substructure which had burned last December at its Keystone quarry with steel supports and added a steel bin. It also replaced a building at its Red Marble quarry southwest of Chewelah, damaged by heavy snows. An $86,000 rock crusher which can reduce 42 in. rock to 4 in. size at the rate of 400 tons per hour was installed this spring at the latter quarry.

Alcoa—The construction of Aluminum Company of America's new aluminum rod, wire and electrical transmission cable plant adjacent to its aluminum operation at Vancouver has been an outstanding development on the west side of the State.

Meadow Creek Mining Co.—Interest in smaller properties throughout all parts of the state is developing. In Ferry County, Meadow Creek Mining Co. is raising money through sale of stock to reopen the Blevens gold-copper property near Kellar. According to D. A. Munroe, president, no money is to be spent until $30,000 is raised and then the amount is to be used blocking out ore already exposed.

Pacific Mutual Silver-Lead Co. has been raising money to continue development work and install a mill at its silver-lead-zinc-copper properties, near Kellar.

Chromium Mining & Smelting Corp. planned to double production of ferro-silicon and ferro-chrome about June 1, operating four instead of two furnaces. About 225 men were to be employed at the Mead plant, according to W. T. McGinnis, the new plant manager.

OREGON—Dant & Russell perlite plant is important addition to Oregon industry.

East Eagle Mining Co. has stockpiled ore carrying values of $12 to $45 per ton in gold at its mines in Baker County and planned to install a mill this spring. It was expected the company's four mines could supply the mill with

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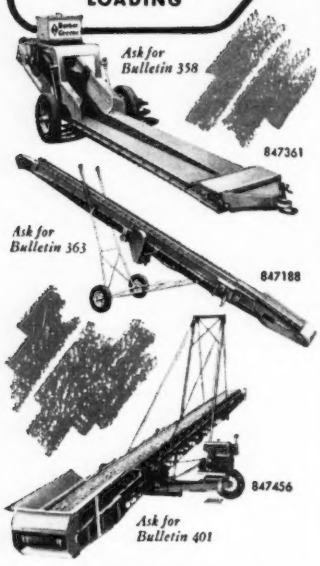

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Oregon *(Continued)*

as much as 100 tons of ore a day.

Fred Bartells, owner of the Champion mine, early this year put in operation a flotation mill built during the recent war by the H&H Mining Co. The mill, located in the Bohemia district southeast of Cottage Grove, was treating copper, lead and zinc ore from the Champion, Musick and Helena properties.

Dant & Russell's new perlite plant at the Lady Frances mine was nearing completion last month. The popping furnace which produces light-weight aggregate used in making plaster was to start operation about the middle of June and the acoustical tile plant will be ready to produce in September. Machinery is being moved from the company's St. Helens plant to the new property in central Oregon.

Brockton-Nevada Mining Co. has started spring dredging operations on its property in Sumpter Valley, near Baker. The company was forced to suspend its dragline operations during the severe winter months. Officers of the company report good results from early production.

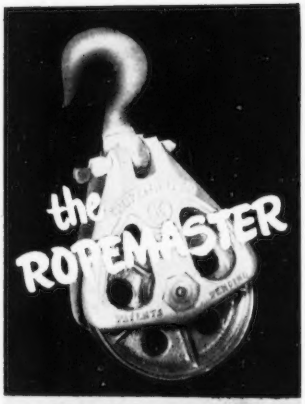
Baker Dredging Co., operating in the same area, also reports excellent prospects for this season's operations.

A.A. Muck and associates are mining limonite ore at Scapoose and shipping it to the C. K. Williams Co. in San Francisco. According to an official of the Williams company, it is proving the best paint pigment of its type found in the west. Three thousand tons of the ore had been shipped in April.

IDAHO — Mining companies are sinking four deep shafts in the Silver Belt.

In the Silver Belt, which comprises territory south of the Osburn fault to the St. Joe River watershed, and east from the Sunshine mine to the Montana state line, there are four deep shaft developments under way.

Polaris-Silver Summit—Adopting a share-the-profits plan similar to the agreement reached between Sunshine, Polaris and Silver Dollar mining companies when the rich Chester vein was discovered in Sunshine workings, Polaris Mining Co. and Silver Summit Mining Co. sank a 3,000-ft. shaft about 5,000 ft. east of the Sunshine discovery. This opened another large silver-copper orebody carrying high values, which has now been proven for a length of 800 ft. and widths up to 15 ft. The operators raised on the ore 100 ft. from the 3,000 level, apparently reaching the apex; they are now sinking a standard, three-compartment winze shaft to the 3,600 or 3,700-ft. level.



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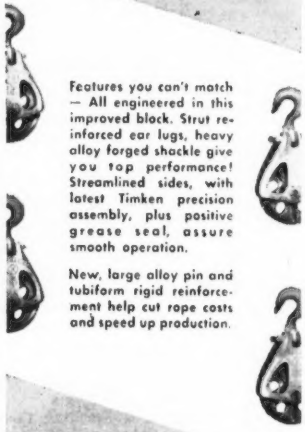

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Six thousand feet east of the Polaris development, the Coeur d'Alene Mines Corp. has a shaft down to 2,800 ft. and has found some commercial ore, but nothing yet of major importance.

Following the success of deep exploration in the western part of the Silver Belt, the American Smelting and Refining Co. and Day Mines interests have jointly undertaken the job of exploring a more easterly portion of the Belt, at the Galena mine near Wallace.

First step in the program—sinking a shaft directly to the 3,000-ft. level—is more than half completed. It is expected that this level will be within the Revett and St. Regis formations which have been notably productive throughout the district. After cutting a station at this deep level, prospecting will be carried forward by extensive crosscutting and drilling. Drifting will follow on any promising structures disclosed.

Hecla Mining Co.—Three miles further east, midway between Wallace and Mullan, the Hecla Mining Co. is developing a block of ground two miles square. A long tunnel has been driven into the property and a mineralized zone developed. Extensive diamond drilling is to follow, according to Hecla's annual report.

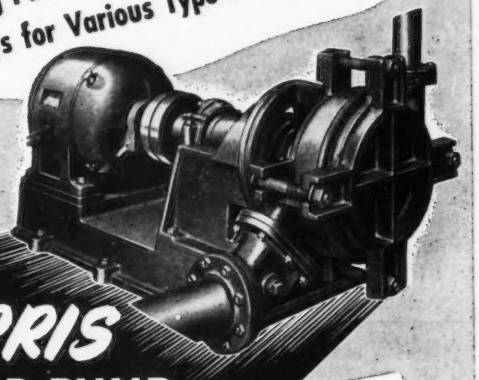
Calera Mining Co.—Of potential importance is the Calera Mining Co.'s cobalt deposit in Lemhi County in the Blackbird mining district. The company, a Howe Sound subsidiary, recently announced that tests had proved the feasibility of extracting high-grade cobalt concentrate by combined roasting and flotation. In addition to these tests, Calera has carried on substantial underground development to confirm earlier diamond-drill results by the U.S. Bureau of Mines. The company will build access roads to the isolated section, and a camp at Forney, Idaho.

New Hilarity, Caledonia Silver-Lead, Mohawk, and United Mines companies are developing at depth the old Caledonia vein system east of a north-south fault which cut off the rich Caledonia orebody. They are crosscutting from the bottom of the North Bunker Hill shaft and will go directly under the town of Wardner. The latter three companies will also prospect the Wolverine, Paramount and Mohawk veins.

Silver Bowl Mining Co. is prospecting a vein system which has produced silver-lead ore in the past. From its old Senator Stewart mine at Kellogg, the company is sinking a shaft to 200 ft. below the Fir tunnel level.

Bunker Hill and Sullivan Mining Co. has discovered a promising lead-silver orebody on the 1,700-ft. level. Operators were driving a crosscut to prospect the Truman vein, which has been developed for a length of 600 ft. and up to the 1,900-ft. level, showing an average width of 12 to 15 ft. and average assays of 8% lead and 5 oz.

Wearing Parts Made of 3 Different Alloys for Various Type Slurries...



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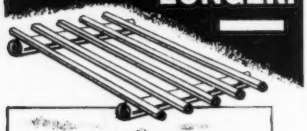

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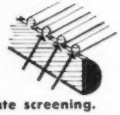

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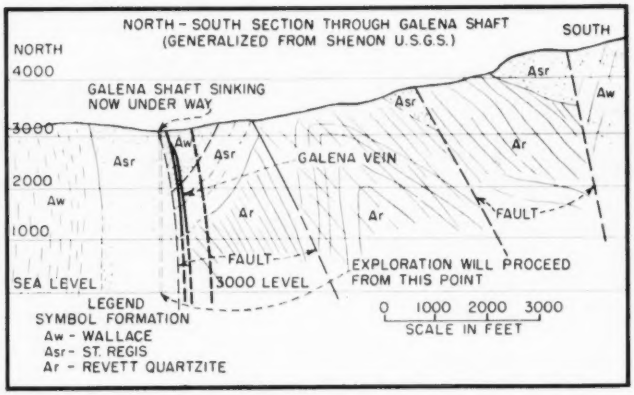


THE GALENA SHAFT is being sunk by American Smelting & Refining Co. and Day Mines, Inc., near Wallace, Idaho, to explore at depth.

Idaho *(Continued)*

silver per ton. The new orebody was encountered on the hanging wall side of the Bunker Hill shear zone 300 ft. before reaching the Truman vein. It shows a width of 30 ft. where intersected by the crosscut and assays an average mineral content better than the Truman vein.

CANADA—The Dominion's mineral production was valued in excess of $806 million in 1948, an all-time high. New development, improved equipment and methods are keeping pace with last year.

ONTARIO

Following are the high spots of most recent development and expansion activity under way in Ontario and Quebec mines.

Jalore Mining Co.—Under exploration are the Ruth and Lacy siderite mines at Michipicoten. Jalore Mining Co., a subsidiary of Jones & Laughlin, has taken a 50-year lease on the mines and has drilled to 750 ft.

Algoma Ore Properties, Wawa, will increase production of sinter this year to 1 million tons. The sink-float plant has been rebuilt.

Steep Rock Iron Mines at Steep Rock predicts 1949 will be a record year, with a 2 million-ton goal. New tonnage is indicated for the "B" orebody, and work has started on uncovering "A" orebody.

Falconbridge Nickel Mines expects to have higher output this year from deep ore of better grade, below 2,000 ft. Lower mining costs have resulted from better wall conditions.

Broulan Porcupine Mines, Pamour, has deepened the No. 1 winze to 755 ft. and established six levels on the northeast claim. New production is due this year from this claim, supplementing salvage work on the main ore zone.

Preston East Dome Mines is deepening the No. 3 winze at South Porcupine to establish six new levels down to the 29th horizon.

New Jason Mines moved equipment in to Casummit Lake mine last winter and is rehabilitating the 150-ton mill to start production this month. New work is planned below the seventh level.

Campbell Red Lake—In the Patricia district, Campbell Red Lake Mines has secured a $2,350,000 loan from Dome Mines for plant construction; output was to start in June.

Dickenson Red Lake Mines, Balmerstown, is to spend $750,000 for development and mill expansion to 400 tons. Flotation and roaster will be added to improve gold recovery.

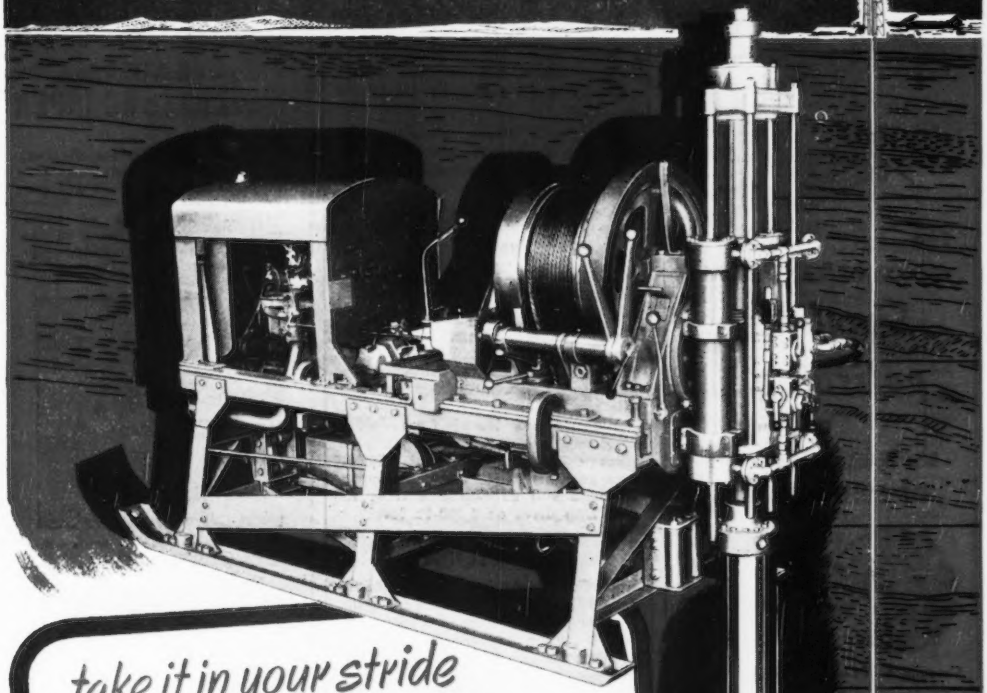
Central Patricia Gold Mines, Central Patricia, is putting down a second winze below the 3,400-ft. horizon, opening three new levels.

Paymaster Cons.—Milling in excess of 470 tons daily, Paymaster Cons. Mines at South Porcupine is aiming at 600-ton capacity. No. 6 shaft, reopened, is being prepared for production.

QUEBEC

East Sullivan—Outstanding expansion and construction program in Canada has been that carried out in recent months at East Sullivan Mines, Val d'Or, Que. Daily average of tons

going down to 5,000 feet?..



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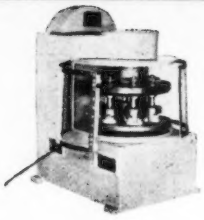

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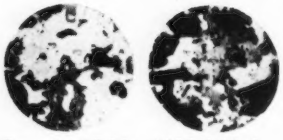

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Quebec (*Continued*)

milled here in May was 2,300, up from 1,718 tons average in March. Operating costs declined to $2.83 per ton.

Anacon Lead Mines, Montauban, has improved ore grade from drilling below the sixth level. Winze has been deepened and headings extended on the sixth level. Milling is expected to increase to 600 tons daily by August.

Senator-Rouyn, Ltd. has doubled mill capacity to 600 tons daily during the year.

Eldona Gold Mines, Noranda, has deepened the shaft from 1,000 to 1,450 ft. and is continuing development.

Golden Manitou Mines is sinking a shaft at Val d'Or to open six levels, to depth of 2,500 ft.

Waite Amulet Mines, Noranda, is sinking a shaft on a new copper deposit.

Noranda Mines, also at Noranda, is erecting a 520-ft. smelter stack to replace No. 1 stack. A second reverberatory furnace is to be brought in this month.

Noranda has leased from Joliet-Quebec Mines, for 25 years, a high silica deposit estimated at 750,000 tons grading 0.75% to 1.0% copper. Noranda will develop this from its own long drive on 1,200-ft. level.

MANITOBA

Howe Sound—An important contribution to Canadian gold production is being made by Howe Sound Exploration Co., operating the Nor-Acme property at Snow Lake. The company completed a 2,000-ton mill which started operating last March and by June had worked up to 1,700 tons daily. The process is standard concentration by flotation and cyanidation of concentration. Some arsenic in the ore may necessitate roasting concentrates before cyanidation.

Howe Sound has spent millions of dollars since the war on developing the property and building the mill. Extensive diamond drilling has indicated 4,860,900 tons of ore, with estimated value of $5.25 per ton. The shaft was down to 960 ft. last month.

Sherritt Gordon Mines, Ltd., in developing its Lynn Lake property, recently set the value of recoverable nickel and copper at $90 million, with good prospects of increasing this tonnage as work progresses to lower levels.

The five-compartment "A" shaft reached its objective of 1,000 ft. in May and the first underground nickel-copper ore was cut at this depth. The company plans deep diamond drilling to a depth of 2,000 ft., where geophysical testing will be carried out at depth.

The pilot plant was to start work in June. The new leaching process is considered satisfactory and concen-

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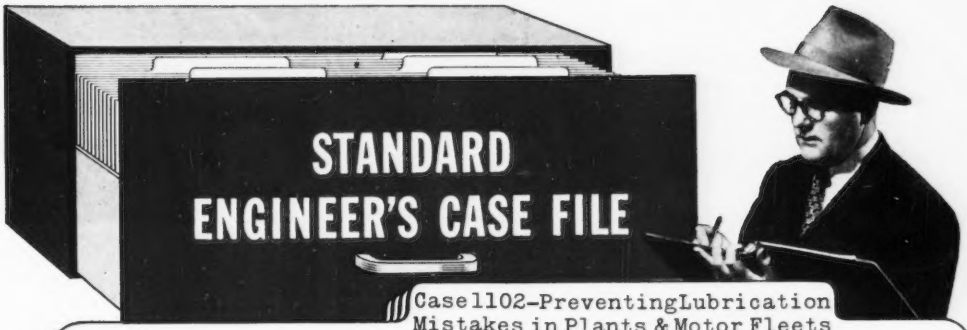
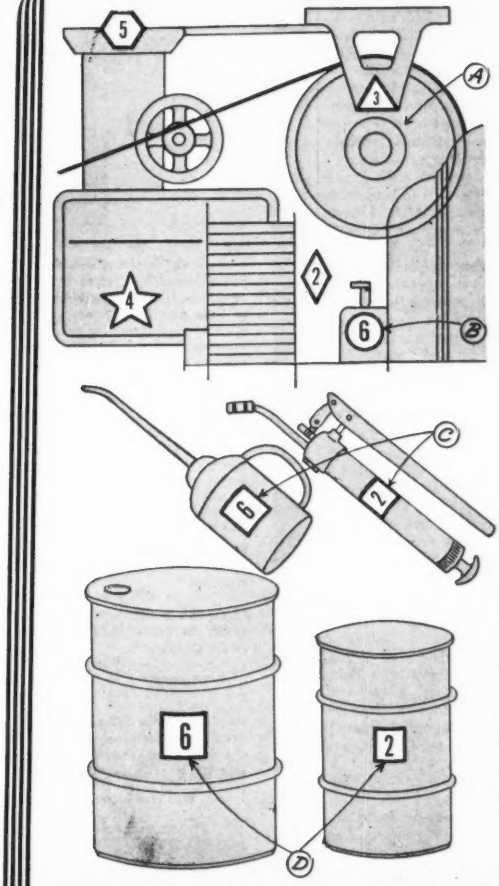


STANDARD ENGINEER'S CASE FILE

Case 1102—Preventing Lubrication Mistakes in Plants & Motor Fleets



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Manitoba *(Continued)*

trates produced from the pilot mill will be shipped to Ottawa, where the leaching plant is being erected.

BRITISH COLUMBIA

Santiago Mines, Ltd. is sinking the main shaft at the Bosun mine in the Slocan district and improving underground facilities. The property has recently been equipped with an electric trammer and a mechanical mucker. Installation of a jigging and sorting plant has enabled treatment of development ore and other low-grade material. Hand-sorted high-grade silver-lead-zinc ore is shipped to the smelter.

Sheep Creek Gold Mines, Ltd. suspended milling last summer at its Salmo parent property, but resumed operations before the end of the year. At the same time the company advanced in the base metals field by developing several properties. The Paradise mine in the Windermere district is scheduled to commence production this summer with a 50-ton mill at Jack Pine, seven miles from the silver-lead-zinc mine and on a lower elevation. Sheep Creek brought into operation during the latter part of 1948 the Vananda Mines, Ltd., gold-copper producer on Texada Island, with a current 100-ton daily output. The company's Lucky Jim silver-lead-zinc mine at Sincton is producing 400 tons daily under high mechanization, compared with 200 when Sheep Creek took over in 1940-41.

Taku River Gold Mines, Ltd., operating the Polaris-Taku mine at Tulsequah, reported a marked improvement in 1948 with the mill handling about 275 tons daily. The company has completed metallurgical tests and plans to construct roasting plants expected to save $150 per ton on ore milled by the summer of 1950. The proposed roaster will eliminate shipment of concentrates to Tacoma smelter and release some $100,000 tied up in shipping equipment.

Torbrit Silver Mines, Ltd., on Alice Arm, started milling operations Feb. 22, 1949. The mine has a 300-ton cyanide mill and a 1,600-hp. hydroplant, the latter commencing operation in late November on Clearwater Creek.

Construction completed during last year included the storage dam, 5,125 ft. of penstock machinery installations, five miles of transmission line and two substations, compressor house, assay office, boiler plant and refinery, shop buildings, three dormitories, mess hall and mine dry, 3,200 ft. of narrow gage, snow-shedded railway, a 94-ft. bridge over the Kitsault River, 2,200 ft. of 6-in. woodstave waterline, a diversion dam, 2,800 ft. of surface airline, and 160 ft. of trestle connecting the coarse ore bin and mine railway. Flotation cells were being added during the spring

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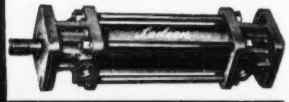

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and production was expected to be boosted to 360 tons daily.

Yale Lead and Zinc Mines, Ltd., is developing seven claims at Ainsworth, recently acquired from Ainsmore Consolidated. The Yale company plans eventually to operate a 300-ton concentrator. A contract has been signed with the City of Nelson for hydroelectric power. Three new compressors have been added to equipment, with a total capacity of 1,050 cu. ft. To provide accommodation for increasing staff and crews, the company has purchased the Hot Springs Hotel and 12 cabins.

Brooklyn-Stemwinder Gold Mines, Ltd., operating in the old Phoenix camp near Greenwood, secured the 80-ton McArthur mill at Greenwood for treatment of gold-copper ore.

Guichon Mine, Ltd., is deepening the 50-ft. shaft to 300 ft. on its copper property near Merritt. The company is considering a mill at the property to ensure more economical operation than is possible with high freight rates to Tacoma smelter.

Canadian Collieries (Dunsmuir), Ltd., control of which was moved from Britain to British Columbia during the year, announced plans to investigate ore deposits on Iron River, Vancouver Island. An electric steel furnace may be erected at Canadian's Union Bay, V.I., if sufficient ore is available. The company also has options on ore deposits in the Quinsam Lake area, from which district ore is being shipped to Wenatchee, Wash., by Coast Iron, Ltd.

Emerald Glacier mine—A mill of possibly 150 tons daily capacity is planned for Emerald Glacier mine on Tahtsa Lake by Dr. Frank Buckland, who optioned the property this spring. Diesel power will be used for the present.

Granby Consolidated Mining, Smelting & Power Co., Ltd., which during 1948 increased production from its Copper Mountain mine by about 25% and net operating profit by nearly 50%, is operating a new Short-Head crusher in the coarse crushing plant at Copper Mountain. It is expected this will increase output about 10%, to 5,500 tons daily.

The company also installed eight new Akins classifiers at the Allenby concentrator to improve recoveries and handle an increase in tonnage.

Hedley Mascot Gold Mines, Ltd., is developing copper property at the south end of Vancouver Island, optioned this spring from Sunloch Mines, Ltd., and Gabbro Copper Mines, Ltd. Hedley Mascot is committed to spend not less than $25,000 in development work to Nov. 1, 1949, and to make further payments of $50,000 in the following three years. A 300-ton concentrator is to be in operation not later than Nov. 1, 1951, and possibly earlier.

Bralorne Mines, Ltd., Bridge River gold producer, is deepening both Em-

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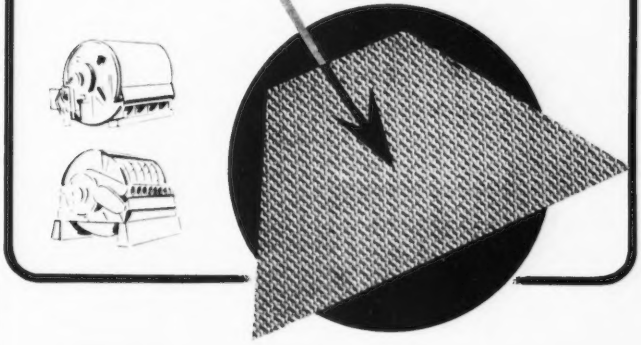

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British Columbia *(Continued)*

pire and Crown shafts by 900 ft. Reconstruction and enlargement of the mill, and further work at the Yakakom, Brominco and Baltic properties will be undertaken when conditions warrant.

Canadian Exploration, Ltd., has changed the milling circuit of its Emerald mine plant, former tungsten producer, to treat lead and zinc ores. In the first 15 days of operation the mill treated an average of 210 tons daily. It is expected tonnage will be gradually increased to 300 tons daily. Power supply has been increased to 1,200 kva. through erection of a new substation by West Kootenay Power & Light Co.

Cariboo Gold Quartz Mining Co., Ltd., installed a new hoist and skip at its mine at Wells, boosting ore handling from 150 tons to 200 tons daily.

Coast Iron, Ltd.—Iron ore deposits on Vancouver Island, at Upper Quinsam Lake, are being worked by a new company, Coast Iron, Ltd. The earlier open-pit shovel method was discarded and ore is now blasted and sorted by hand to bring quality and grade of ore up to smelter requirements. Shipments to Wenatchee, interrupted for a time this spring, were resumed in May at a rate of 2,000 tons monthly, with a product of about 65% iron. The company was formed by Privateer Mines, Ltd., and Firth-Kershaw (Exports), Ltd., Vancouver.

Base Metals Mining Corp., with Chamberline Management Corp. in charge of operations, has stepped up output at its Field mine, to more than 4,000 tons per month. A new 500-cu. ft. diesel-powered compressor has been installed in the mining plant and additions are being made to the mill to take care of larger tonnages. The corporation recently acquired the Cork Province mine in Slocan district and shipments of lead-zinc-silver ore were expected to start May 15. A new company, Vancouver Island Base Metals, Ltd., was formed to take over the former Twin-J property near Duncan, V.I. A new headframe was erected on this property. Production, with a 150-ton mill, is expected to begin soon.

SASKATCHEWAN

The value of Saskatchewan's mineral production last year was about $3 million more than it was in 1947. W. James Bichan, Director of Mineral Resources, reported that the outlook for the mining industry in 1949 is more favorable than at any time previous, based on active mineral developments now under way or planned for the near future.

Hudson Bay Mining & Smelting Co.'s Flin Flon operation this spring was milling more than 5,000 tons a day, although mine production is down from the wartime peak.

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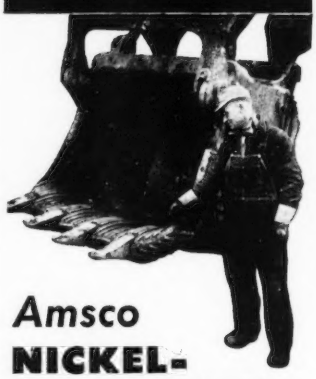

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copper and zinc in the Dominion, Hudson Bay also turns out substantial quantities of gold, silver, cadmium, selenium and tellurium. Ore reserves are estimated at better than 20 million tons, averaging 2.99% copper and 4.24% zinc. Bulk of the underground work below the 3,000-ft. level this year is being done in Saskatchewan.

The company began construction of a slag-fuming plant this year on the Saskatchewan side of the border which will cost $5 to $6 million. The plant is expected to be completed in 1950 and will recover zinc from residue stockpiles as well as improve zinc recovery from present production.

Saskatchewan Minerals Corp., Clay Products Division, has under way a program to develop reserves of high-grade ceramic and other clays. A coring drill operated last year in the area between Eastend and Estevan and drilled some 3,500 ft. of shallow holes and enlarged the information available on stoneware, ball, fire, and china clays of the Whitemud geological series. Reserves for several years' demand have been blocked out, and laboratory facilities are being expanded to allow close control on clay shipments as well as research on possible new uses and markets for the clays.

YUKON

Yukon Placer Mining Co. will open a new operation on Big Gold Creek in the Sixty Mile area this season. Charles Herbert, one of the five partners in the company, will be in charge of the crew at this dredging operation. The other four will supervise between 25 and 30 workers as follows: Earl Ellingen on Fourth of July Creek; Glen Franklin on Canyon Creek; Harold Schmidt on Walker's Fork, and Leonard Stampe on Jack Wade Creek.

Yukon Cons. Gold Corp. expects to operate dredges No. 3, 4, 6, 7, 8, 10 and 11, according to C. E. McLeod, manager. Stripping will be done on Upper Sulphur Creek, but it has not been decided whether dredge No. 9 will operate. Costs are mounting but a profit is being made. Recovery of gold in the Dawson district amounted to $1,675,751 from 7,200,017 cu. yd. in 1948.

Miller Creek Placers will employ a small crew at its property west of Dawson in the Sixtymile district. Yukon Exploration Co., Ltd. will operate a dredge and other mining enterprises on Big Gold this season.

United Keno Hill Mines, Ltd. reported discovery this spring of a vein on Keno Hill entirely separate from the workings of the Hector Calumet on Galena Hill. The vein was established for 400 ft. and reported to average 11 ft. in width with values from bulk sampling running 10 to 20% lead, 10 to 15% zinc, 50 to 100 oz. in silver, and 0.3 to 0.5 oz. gold to the ton.

The company was to drive an adit

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Yukon *(Continued)*

700 ft. on the new vein to give about 200 ft. of backs. A new cyanide unit was to be added at the Elsa mill and was to be operating in June. United Keno expected shipments to the outside this season to be the largest since operations started.

ALASKA — Dredges new and old go into operation in Alaska mining districts.

Indications are that Alaska's 1949 gold production, as in 1948, will be almost entirely from placer mines. According to a report on the Territory's mineral industry in 1948 by Ernest N. Patty, president of Alluvial Golds, Inc. and Gold Placers, Inc., more than 99% of last year's gold was produced by placer mining.

Alluvial Golds, Inc. is building a new gold dredge on Thistle Creek in the Dawson Area, with H. M. Holbrook in charge of the operation. The company also has a crew of 26 men on Woodchopper Creek near Fairbanks, with Henry Ginrich in charge.

Gold Beach Dredging Co. will have a new dredge, operated only briefly last year, near Nome this season. George Hellerich, manager of the Brinker-Johnson mine on Caribou Creek last year, will be in charge of Gold Beach's new dredge, with a crew of 25 to 30 men.

Jack LaCross, partner with Gene Janeway and Chester Milligan in a dredging operation on Ophir Creek in the Council district near Fairbanks, claims his four-foot dredge is one of the few dredges in the Territory, if not the only one, with its own power plant. With a Pelton wheel at the end of a ditch and pipeline, the dredge is powered with electricity.

The Cleary Hill Mining Co. will not reopen its Cleary Hill mine this season, but will operate a placer property at Tofty, according to Ralph Wyer, president of the company.

Among miners who have left Fairbanks recently to work their properties this season are Cole McFarland and Wayne Hubbard, with ground on Little Creek and a small dredge on Gaines Creek; Mathison and Savage, at Spruce Creek; Peter and John Miscovich, at Poorman Creek and Flat; Ernest N. Patty of Alluvial Gold Placers, at Woodchopper Creek; and James K. Crowdy of the New York-Alaska Gold Dredging Co., at Nyac on the lower Kuskokwim River. Rosander and Reed has moved its crew from Ophir out to Yankee Creek, having opened the road to the mine. Gus Uotilla is drilling on Ophir Creek.

Myrtle Creek Mining Co. operators, Frank Moliter of Seattle and John Repo of Wiseman, have purchased property on upper Gaines Creek from

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the A. A. Shonbeck estate. New operators have ordered a steel hull for the dredge and plan to be dredging by September. This will be the first operation on upper Gaines Creek since the war.

The "Binocular" prospect on Glacier Creek in the McCarthy district is to be developed this year, under the sponsorship of J. B. O'Neill. Samples sent to the Bureau of Mines were reported to be composed essentially of chalcocite and malachite, indicating copper of between 71.9 and 79.8%.

Fred D. Crane and M. E. Kelly, of Nome, are developing the Cape Mountain tin deposit, about 100 miles north of Nome.

CHILE — San Vicente Steel Plant will require 350,000 m. tons of iron ore annually.

San Vicente Steel Plant just south of Talcahuano port, is about 35% completed. It will supply Chile with commercial pig iron and steel at the rate of 235,000 metric tons of steel per year. The total cost of the plant has been calculated at $90 million. The plant was designed by Koppers and its capacity can be increased three times as the need arises.

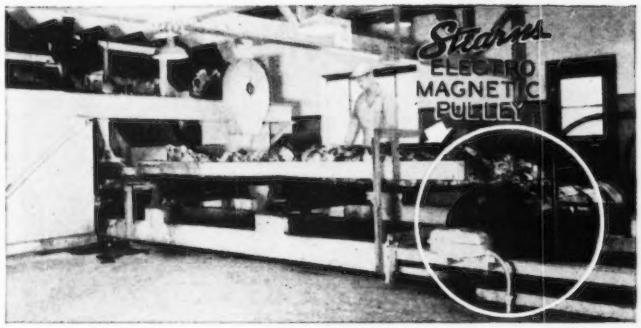
Iron ore will be obtained at the rate of 350,000 metric tons a year from either the El Tofo or the Romeral deposit. Both of these properties belong to Bethlehem Chile Iron Mines and are high grade hematite and magnetite deposits running 60% iron.

Lime flux at the rate of 105,000 metric tons a year will be shipped from the extensive deposits on Guarello island. Coal for the blast furnace will be hauled by rail from the nearby Lota and Schwager coal mines. In order to produce a suitable blast furnace coke a certain amount of high grade coking coal will be imported from the States. Coal needs will amount to 327,000 tons per year.

The San Vicente plant is to be over two miles long, occupying an area of 550 acres. Electric power will be supplied by the Abanico hydroelectric power plant already built by Endesa. A labor force of 4,000 is building the steel plant.

The Export-Import bank has supplied most of the capital, in the form of a $48-million loan, plus $4 million in equipment. Other financing came from Corporacion de Fomento, a Government agency; the Chilean Federal Reserve Bank; Anaconda Copper Mining Co.; Kennecott Copper Corp. and private Chilean capitalists.

Bethlehem's Romeral deposit—High-grade hematite-magnetite deposits running 60% iron, with low sulphur and phosphorus content, stretch along a narrow belt near the coast of Chile, from Serena in the south to Copiapó in the north. Of these deposits, the largest and best known are



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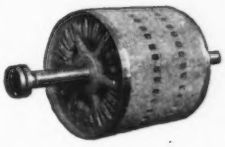

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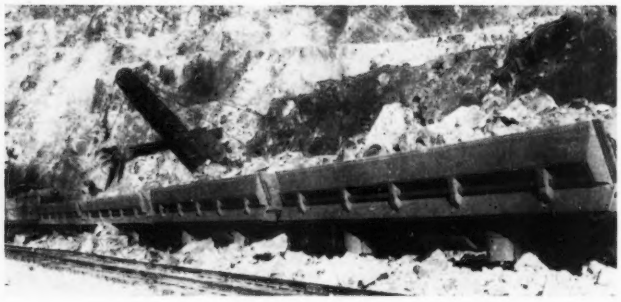

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Chile *(Continued)*

Bethlehem's El Tofo and Romeral, and the Algarrobo, which is southwest of Vallenar and belongs to a Dutch company.

El Tofo has been supplying Bethlehem with high-grade ore for a number of years. Though during the war years little ore was shipped, in 1948 the output reached 2,711,000 or a million tons more than shipped in any previous year. If production is kept up at the present rate the output will reach about 3,100,000 this year and El Tofo will not last many years longer.

To replace El Tofo, the Bethlehem company a few years ago bought the Romeral deposit containing 18 million tons of 60% iron ore. Late in March an agreement was signed between Bethlehem Chile Iron Mines and the Compania de Acero del Pacifico, which company is putting up the San Vicente Steel Plant. Bethlehem Chile undertakes to mine a million tons of ore a year, of which 350,000 tons will be delivered to Acero del Pacifico at the start. This yearly amount will increase with completion of Acero del Pacifico's blast furnaces at Huachipato. According to this agreement, Bethlehem Steel Corp. was to contribute $6,500,000 and the Pacific company $2,500,000 of the required investment.

A new railroad will have to be built from the Romeral mine to the bay of Guayacan, south of Coquimbo. Buayacan boasts the best bay in Chile, so there will be no difficulties in loading the ships. Romeral is not large as iron deposits go, but is high-grade, compact and very near the coast, making the construction of the railroad to Guayacan Bay a good investment.

The Paipote Smelter—Chilean miners for the last 30 years have been asking the Government to build a custom smelter to reduce to blister the copper-gold-silver ore and concentrates now shipped abroad in the raw. Such a smelter was designed by Allis Chalmers but the war prevented its going up.

About a year and a half ago Caja de Credito Minero signed a contract with Allis Chalmers whereby the latter undertook to supply within two years all the necessary machinery and materials not obtainable in Chile for the construction of the smelter. Estimated cost of the Paipote smelter is about $8 million, including imported machinery and materials, labor, engineering, and Chilean materials such as cement and timber. Imported machinery, structural steel, reinforcing steel, refractories, etc., will weigh about 9,000 tons and will cost close to $4 million, delivered to Chile.

A labor force of 600 men is at work on the smelter and camp. It is hoped to have the smelter finished early in 1951. Chilean funds exclusively are financing the Paipote project.

The smelter will be able to reduce an average of 450 metric tons of raw charge per day including fluxes. The

charge will be high in silica and alumina, because by far the greater part of it will be raw copper and gold ores. The one reverberatory furnace is to be 105x28 ft.; the two converters, 17 ft. 4 in. x 10 ft. The gases from the reverberatory will go through two boilers which will produce enough steam to run two 1,250-kw. Allis Chalmers turbo-generators and one turbo-blower which takes 550 hp. An excess of 1,250 kw. will be produced, —and can be sold—above the power needed to run the smelter, which is entirely mechanized. Pulverized Chilean coal of about 12,600 Btu. or oil can be used to fire the furnace.

Water to feed the boilers, for the casting machine and for the camp will be obtained from four wells already sunk, which can deliver 550 gpm.

Caldera port—Paipote is the junction between the Longitudinal railroad from Santiago to the port of Iquique, and the branch railway from Caldera to Loros built along the Copiago Valley. Paipote smelter is to be served by the Caldera port, which is considered one of the best in Chile. Here the Government is spending about $100,000 this year to repair harbor construction. The railroad from Caldera to Copiapo, too, is to be improved.

PERU—A. S. & R. subsidiary is drilling on Toquepala copper property in Southern Peru.

The immediate future of the Peruvian mining industry depends mainly on the stabilization of local economic conditions. With the several systems of exchange control which have been tried out in the last few years, the Peruvian currency has fluctuated from 6.50 soles per dollar in 1945 to a new low of over 18 soles per dollar in May of this year. Up to a few months ago miners had to turn in the full dollar value of their exports to the Government, and received in exchange soles at the official rate of 6.50 per dollar. At present miners get 55% of their exports in dollar certificates which they can sell in the free market for over 18 soles, turning in the remaining 45% which is converted into soles at the official rate. The result has been a slight boom in mining, which may become important if and when the Government gives miners a larger proportion of their exports in certificates.

Gold miners have been getting 100% of their export dollars in certificates for quite some time, a concession which was essential in that particular case, and which prevented a collapse of the entire gold industry. Whether the Government will decree what is equivalent to a free trade is very doubtful, since general living conditions have definitely become worse since the 55% decree was issued.

The Northern Peru Mining & Smelting Co., a subsidiary of American

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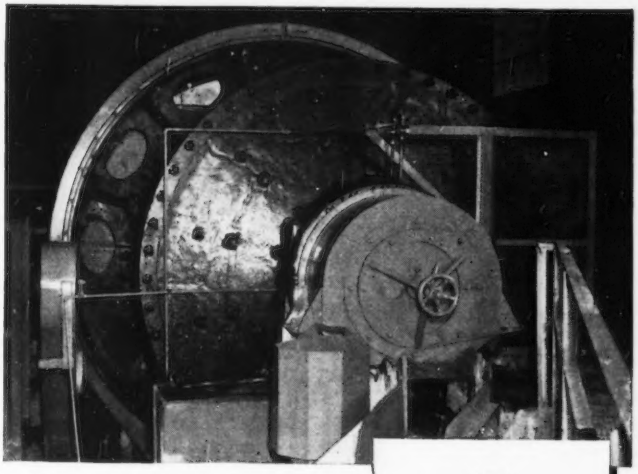

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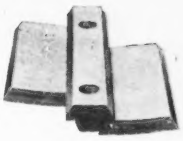

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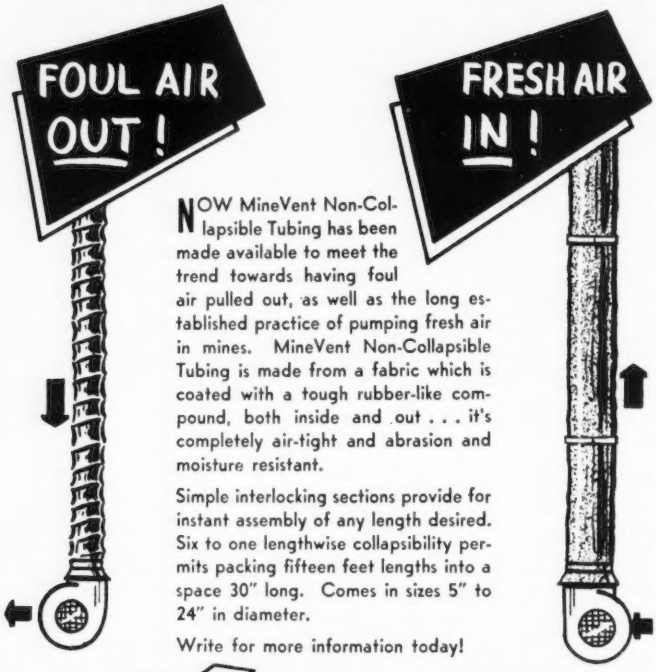

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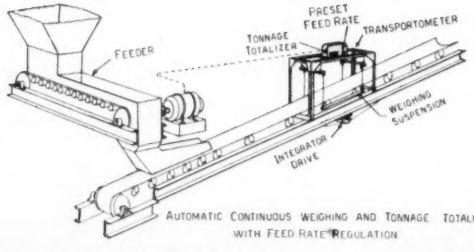

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Peru *(Continued)*

Smelting & Refining Co., purchased the Toquepala property in Southern Peru in October, 1941. This property contains a large outcrop of a disseminated "porphyry copper" ore occurrence and lies in a remote and mountainous desert section about 60 airline miles from the coast. Litigation pertaining to the title delayed work here until recently. The company is now planning its drilling campaign to establish that sufficient ore exists to justify an undertaking of such magnitude. A truck road is under construction to connect Toquepala with the existing road-net, and camp facilities are being erected.

If the campaign works out as expected, road, railroads, and port facilities, in addition to mine, mill and smelter, will be required to bring the property into production.

The Banco Minero del Peru is erecting a 100-ton sink-and-float plant and a 50-ton mill for concentrates at Huachocolpa. These two plants will be finished this year and will operate as a supplement to the 150-ton concentrator that the Banco started to operate a few months ago. The Huachocolpa region is growing with the aid of these custom mills, and promises to be a very important source of lead, silver, zinc and copper ores.

Compañía Minera Atacocha, located near Cerro de Pasco, and one of Peru's most important lead-silver-zinc producers, will soon finish the installation of a new 330-ton concentration plant. Atacocha will thus increase its daily capacity to 500 tons.

Tembladera Cement Plant—A new cement plant is to be erected at Tembladera, near the port of Pacasmayo, in Northern Peru. The plant will fill a long-felt need for Portland cement in that region, and will be partly financed by the Export-Import Bank. It will have an initial production of 2,000 barrels a day and will be operated by means of diesel-electric power.

The Corporación Minera Castrovirreyna has installed a 150-ton concentration plant at the Caudalosa mine, near Castrovirreyna, inland from Pisco, and is erecting a 65-ton plant for concentrates. Caudalosa was a very important mine in the late '80's, but was later abandoned. The Picasso family have rejuvenated the mine, which promises to be a good producer of silver-lead ores.

Negotiations are now under way for the sale of Peruvian iron ores abroad. Chile has been exporting over 2½ million tons a year of iron ore to the United States, and Peru could do likewise, utilizing its large iron deposits at Marcona. These deposits, which have very large reserves of high-grade hematite, are located south of Pisco, in Southern Peru, and close to the natural harbors of San Juan and San Nicolás. Marcona has been

thoroughly prospected and diamond-drilled.

Several important mining projects are marking time until Peru's economic situation becomes more stable.

AFRICA—Shaft-sinking in Free State may eventually produce 18 million tons yearly.

Outstanding developments in South African mining include the opening up of the new Free State goldfields and rich areas of the western Witwatersrand. More coal mines are being started to replace those nearing exhaustion or to increase production, and an oil-from-coal industry is projected. Base mineral mines are increasing production to meet the demand for critical minerals.

American capital is represented in some of these developments. Kennecott Copper Corp. of New York is interested in the development of new mining areas in the Union and with Anglo-Transvaal Consolidated Investment Co. it has formed a company, Kennecott-Anglovaal Exploration Co., Ltd. Ladenberg Thalman & Co. and Lazard Freres & Co. of New York are also actively cooperating with British and South African industrialists in the development of mining and industrial projects in American Anglo-Transvaal Investment Corp., Ltd., which has an authorized capital of £5,000,000 ($20 million).

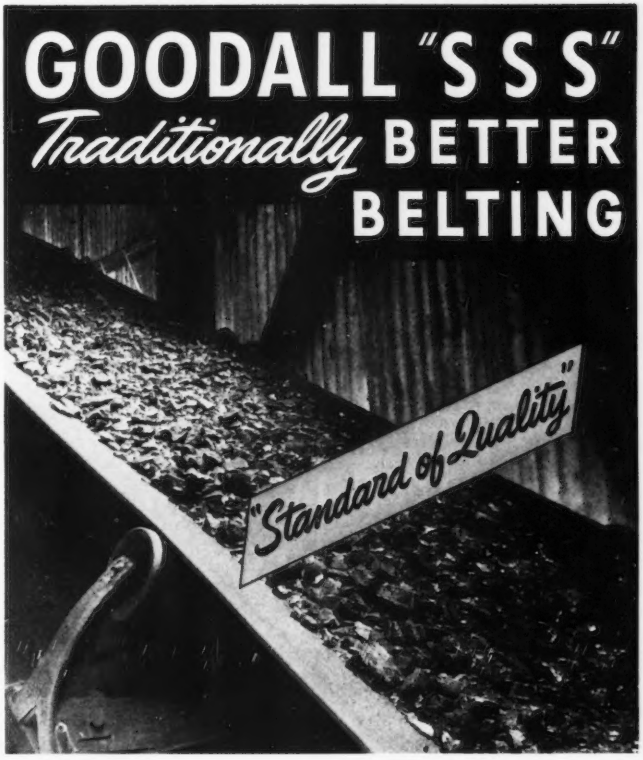
In base minerals, American Metal Co., Ltd., and Newmont Mining Corp. are interested in Tsumeb Corp. in Southwest Africa, and the O'Okiep Copper Co., Ltd., in the Cape Province.

American know-how is involved in the oil-from-coal industry sponsored by Anglo-Transvaal Cons. Investment Co., Ltd.

West Wits Line—The West Wits line, between Krugersdorp and Potchefstroom, gives promise of much wealth when all the mines being developed reach full production. There has also, however, been very heavy expenditure in bringing them to production.

Libanon gold mine became the Union's first new post-war gold mine when it went into production in March this year. It milled 58,000 tons the first month and 65,000 tons in April. Gold output for the two months was 8,564 and 10,084 ounces fine respectively. Because of the war, 13 years elapsed between the time the first sod was cut at Libanon's No. 1 shaft and the production stage. Capital expenditure to date is nearly £6,100,000 (about $24,400,000) which will be increased to £6,500,000 (about $26,000,000) when milling capacity is up to 100,000 tons a month.

Blyvooruitzicht, also on the West Wits line, is something of a wonder mine. High values have been encountered in its development on Carbon Leader



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SEARCHLIGHT SECTION

Africa *(Continued)*

Reef—between 524 in.-dwt. a ton and 758 in.-dwt.—and payability has been practically 100%. It is news when it is not 100%. In the first four months of this year, Blyvooruitzicht produced 160,796 oz. of gold and the average value per ton milled was 15.387 dwt.

West Driefontein, next to Blyvooruitzicht, has also given up to 100% payability in its development.

Nearly £38,000,000 capital has been sunk in companies operating Libanon, Venterspost, West Driefontein, Blyvooruitzicht and Doornfontein mines on the West Wits line.

Late in May, two shafts were started for Stilfontein Gold Mining Co. in the Klerksdorp district. One shaft will go to only 2,750 ft. and the other to 4,750 ft. Development is expected in the shallower shaft in two years and in three years in the other. Gold production is expected to start in early 1953.

East and Central Witwatersrand—On the east and central Rand, existing mines continue their development programs, and some have acquired new claims. East Rand Proprietary Mines (ERPM), Daggafontein, Crown Mines, East Geduld and Grootvlei still lead as the major producers.

East Rand Proprietary Mines, the leader, which had an output of 192,069 ounces in the January-April period, is undertaking further deep level expansion. A series of sub-incline shafts is being sunk from the 8,000-ft. horizon.

Different mining methods will have to be adopted below 8,000 ft. Blocks of unpayable ore can be left in situ only when they are large enough to form adequate pillars. In highly payable areas it is necessary to extract the whole of the reef body, as leaving comparatively small remnants of unpayable gold increases the hazards of mining payable ore.

Mr. G. V. R. Richdale, chairman of ERPM, told shareholders recently it would probably be necessary to work the ultra-deep level ground in the central section of the mine so that stope faces formed, as nearly as possible, a straight line advancing at a uniform rate over several levels.

This longwall system of mining would reduce to a minimum the number of dangerous remnants created by converging stope faces and facilitate ventilation.

It was planned to begin long wall faces advancing east and west from the line of raises on reef which would be developed above each sub-incline shaft sunk from the 8,000-ft. horizon.

Crown Mines has reached a depth of 8,928 ft. at its deepest point, and the rock temperature is around 109° F. Major improvements have been made in ventilation to combat serious increases in rock temperatures. A new cooling plant for No. 16 shaft is to be operating before next summer.

Free State—Latest information about the Free State is that activity will be considerable between 1951 and 1953, when production is expected to start. In the Anglo-American group, Welkom mine is expected to start early in 1951, Western Holdings in mid-1952, Free State Geduld at the end of 1952 and President Steyn in 1953. Freddies North and South mines are expected to reach reef in the first half of 1951.

St. Helena mine's No. 3 incline shaft (30 degrees) has been completed to its final depth of 2,928 ft., and development has started. Apart from reef development, No. 2 south drive and No. 4 south drive are being driven to connect with No. 4 vertical shaft. The total footage driven to the end of April was 5,355 ft. On Basal Reef, 2,355 ft. was sampled and 950 ft. was payable, averaging 26.5 dwt. a ton over 13 in. (344-in. dwt). No payable values were disclosed in the 245 ft. sampled on Leader Reef.

Provided there is no delay, No. 4 shaft is expected to intersect Basal Reef at 2,000 ft. in July. The shaft will be continued to a final depth of about 3,000 ft.

Before the year's end it is hoped development will have given sufficient information to justify a decision to erect a reduction plant at St. Helena.

Welkom mine's No. 2 shaft is expected to intersect Basal Reef at the end of the year, which will allow development to start early next year. It has been sunk more than 1,640 ft. Despite water-bearing fissures requiring cementation, considerable progress has been made in No. 1 shaft which is now more than 1,000 ft. deep.

It is proposed to connect the two shafts as soon as possible and underground development, which should be well advanced by the end of 1950, is expected to allow sufficient production on a basis of 50,000 tons a month early in 1951. A reduction plant bought from Springs Mines, Ltd., is to be erected adjacent to No. 1 shaft.

Western Holdings—Basal reef is expected at 4,200 ft. in No. 1 and 2 shafts which Western Holdings, Ltd., is drilling, and No. 1 is expected to reach that depth towards the end of 1950. Both shafts will be sunk to a final depth of 5,200 ft., and by the middle of 1951 the underground connection between the shafts should be well in hand. The company plans by that time to start the drive northwards to connect with the drive Free State Geduld will start at the same time to develop the area between the boreholes on the farm Geduld, both of which gave phenomenal values when they intersected Basal reef—23,037 in.-dwt. and 12,528 in.-dwt. Production is expected to start in mid-1952.

Free State Geduld's initial production should be possible by the end of 1952, but this date is dependent on deliveries of material and adequate electric power and water supplies. Two shafts

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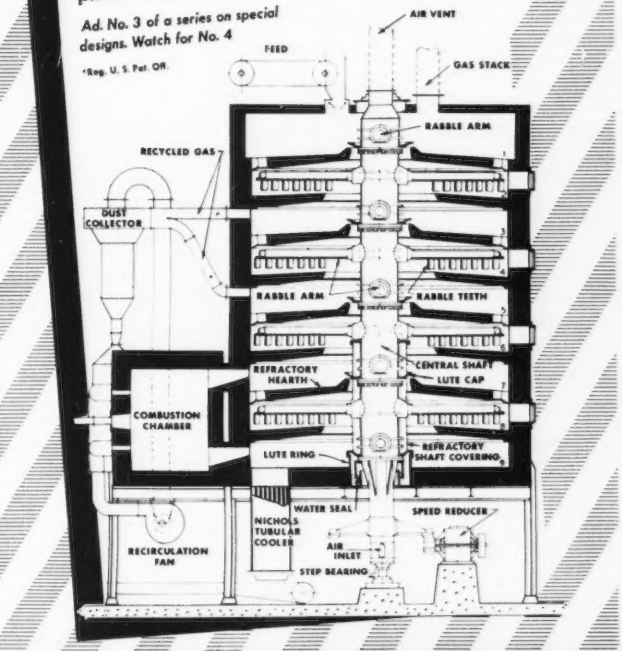

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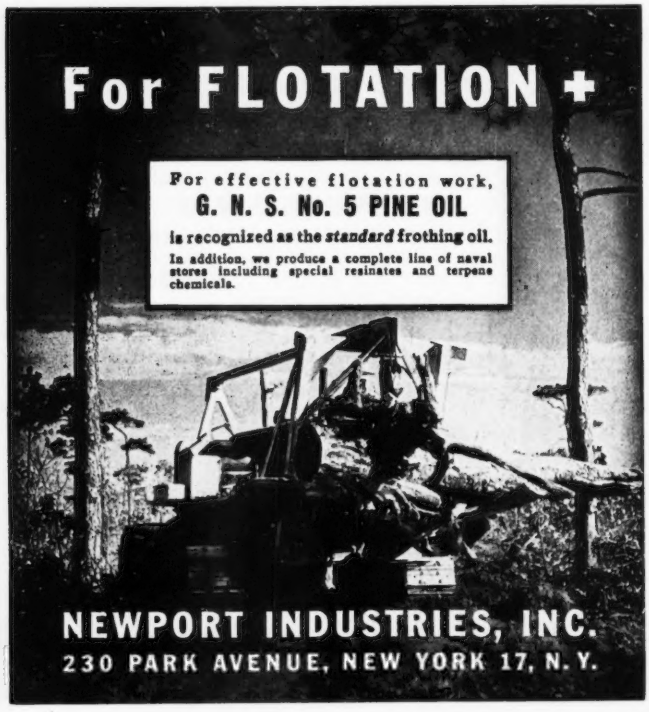
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Africa *(Continued)*

are being sunk. By the end of 1951, work should begin on drives connecting the two shafts and a drive south to connect with the drive from Western Holdings No. 1 shaft.

President Steyn's No. 1 and 2 shafts have recently started and they are scheduled to intersect basal reef at 4,200 ft. and 4,900 ft. respectively in 1951.

Development from No. 1 shaft should be possible before the end of 1951. Production on an initial basis of 50,000 tons a month is expected in early 1953.

The chief difficulties experienced in the Orange Free State shaft sinkings and other development include the shortage of steel for headgears, shaft equipment and foundation reinforcement, delayed deliveries of essential machinery and equipment, shortages of skilled workers and water shortages. Large quantities of underground water have been intersected during shaft sinking and required cementation.

In the light of present knowledge, the O.F.S. goldfield is regarded as having a potential capacity for 12 producers. Annual output is expected to be about 18 million tons by 1962, and to continue for 30 years.

Diamonds—Changes are taking place in the diamond industry. Dutoitspan in Kimberley, which has been dormant since March, 1947, reopens on July 4 when Bultfontein, which has been operating for the past four and one-half years, temporarily closes down. Meantime, certain primary development below the 1,600-ft. level will be undertaken at Bultfontein and surface plant overhauled.

In the Orange Free State, Jagersfontein is expected to resume full production shortly. New crushing and washing plant was brought into commission on July 1.

Premier mine, near Pretoria, is due to resume full-scale production on Jan. 1, 1950, dependent on the arrival of plant and machinery ordered abroad.

Favorable results which were obtained with a sink and float method of concentration at Premier mine have prompted de Beers Consolidated Mines to install a plant of similar design and 10 tons an hour capacity in Kimberley to enable tests to be made on the blue ground from Bultfontein, Dutoitspan and Wesselton mines.

Certain experiments on extracting very small diamonds from vibrating grease table concentrates by electrostatic separation have been successful, and this feature of operation is being developed.

In South-West Africa, benefits from increased mechanization have been obscured by increases in cost of living allowances and higher prices for mining supplies. Various innovations for stripping and mining have been developed. They include portable conveyor units and stacker conveyors

mounted on Sherman tanks which will be brought into operation this year.

Base Minerals—Better railway truck facilities are enabling base mineral producers to meet the world market for their products. Record shipments of manganese are leaving Durban harbor, mostly for the United States. Most of South Africa's asbestos, chrome, corundum, manganese, mica and vermiculite went to the United States last year.

Research—The Transvaal Chamber of Mines continues its research on many mining problems, and laboratories are being extended at a cost of £150,000 ($600,000). Further research will be undertaken in silicosis and the infection of timber by fungus. The new facilities will make possible the investigation of new and untried methods of improving the quality of mine air—an important factor in deep and hot mines.

Much of the work the Chamber's laboratories have undertaken in dust and ventilation problems is recognized internationally as of major importance.

The diamond industry is also actively engaged on research.

AUSTRALIA—Cockatoo and Koolan Islands hold promising hematite deposits.

In an effort to develop an alternative source of iron for the Iron Knob deposit in South Australia, interest has shifted to two small slands in the Yampi Sound, off Derby, Western Australia.

Australian Iron & Steel, Ltd., of the Broken Hill Proprietary combine, has been busy since the end of the war on Cockatoo Island installing crushing plant and loading equipment. The hematite orebody runs up to 69% in iron, with total deposits estimated at 120 million tons. The ore will be shipped to the Port Kembla, N.S.W., blast furnaces of A.I. & S. for smelting.

The breaking of iron ore on Cockatoo Island will follow the practice developed at the Iron Monarch, South Australia, and the method of loading will be similar to that followed at Whyalla, the South Australian ore port. There is a tide differential of 35 ft. and in order to minimize the drop of ore into ships, the end section of the boom of the loading conveyor is hinged and counterweighted. This enables it to rise and fall with the vessel. The whole of the jetty, including piles and superstructure, are of steel.

Equipping of the deposit for fully mechanized operation has been accomplished largely through Australian engineering resources. The only major imported items are the diesel generating sets for power supply and the

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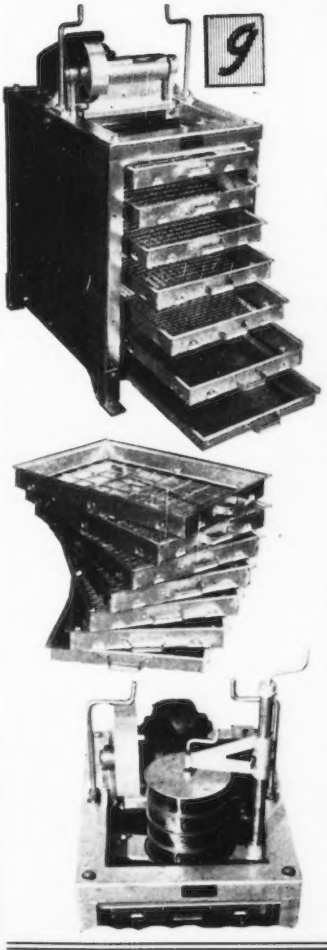

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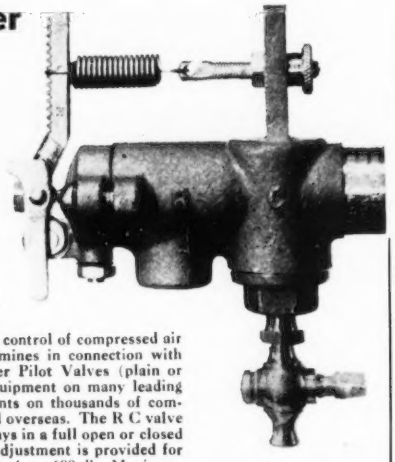

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Australia *(Continued)*

chassis of the diesel quarry trucks. The 84x60-in. jaw crusher is the largest crusher ever made in the British Empire, according to A.I.&S. The two 4-cu. yd. electric shovels are also entirely Australian-made. The installations, including housing for staff and workers, have cost A.I.&S. about $5 million. To keep the 170 construction workers and their families on the barren island supplied with fruit and fresh vegetables, an artificial garden has been built up with soil from the mainland, four miles away.

H. Brassert & Co., the Anglo-American mining engineering organization, holds the adjoining lease on Koolan Island, variably estimated to contain 60 to 100-million tons of similarly high-grade ore. Under the terms of its charter, Brassert must start operations very soon and find an outlet for the ore in Australia. Plans to set up a major iron and steel industry in Western Australia have not materialized. Government regulations prevent the exportation of the Koolan iron ore, although American and Japanese smelters would be ready takers.

Considerable development work is going on at the Barrier, New South Wales, one of the world's important lead-zinc lodes. Object of new shaft sinkings and exploratory drillings is not only the maintenance of ore reserves but also a substantial increase in current production under a five-year schedule inaugurated in December, 1945.

New Broken Hill Consolidated, Ltd., one of the Barrier mines, has made a new capital issue to finance an extensive program of development and re-equipment under the five-year schedule.

Plans provide for an independent mill on its leases to replace the additional units originally proposed at The Zinc Corporation's mill, and installation of an underground crushing station. Provision has also been made for employee housing and staff facilities.

Capital requirements to the end of 1952 will be in the order of $5 million. Ore production from New Broken Hill's leases increased from 3,468 tons in 1945 to about 109,000 tons in 1948 and is expected to reach 173,000 tons this year and 242,000 tons in 1952.

North Broken Hill, Ltd., is completing its No. 3 shaft, a concrete-lined, steel-framed elliptical structure which will accommodate two main cages, two skips, an auxiliary cage and compartments for ladderways and general services. It is the first shaft of this type to be sunk in Australia. Workshops and administrative offices are being transferred to the new shaft area.

North Broken Hill's exploration department has cast its eye on mining fields outside the Barrier and on possible new mineral-bearing territories. Several old fields are being examined to determine the likelihood of profit-

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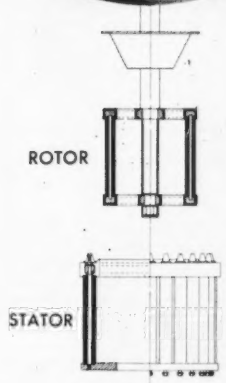

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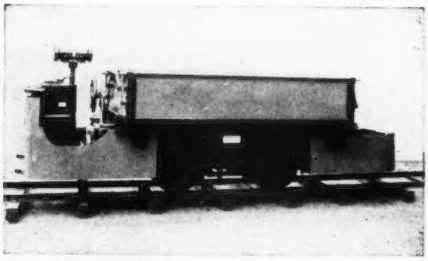

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Australia (*Continued*)

able production of lead, copper or gold. The company's geologists are studying two concessions which have been obtained in New South Wales and Tasmania. The Zeehan field in Tasmania, in which both North Broken Hill and Broken Hill South are interested, continues to hold out promising prospects in spite of its declining fortunes in the last decade. Active exploration is also in progress in the Cobar-Nymagee copper belt in New South Wales.

The Risdon Works, Tasmania, of the Electrolytic Zinc Co. of Australia, Ltd. (Australia's only zinc refinery) has installed a flash roaster and is installing a second roaster of this type to handle increasing supplies of concentrate from the Barrier and from its own mines. Roasting was carried out in two multiple-hearth modified Skinner furnaces. The new flash roasters are based largely on furnaces developed at Trail in British Columbia.

Mount Morgan, Ltd., Queensland, has taken up additional prospecting areas in search of payable copper ores. It now holds 22½ square miles. A drilling campaign is getting into swing. With Mount Lyell and Aberfoyle Tin, Mount Morgan holds an interest in a new concern, Australian Drillers Pty., Ltd. This concern provides the services of a Canadian field superintendent and of experienced Canadian drill runners.

Aberfoyle Tin, N.L., Tasmania, is deepening its main shaft by 240 ft. to open up new levels at 747 ft. and 867 ft. A carefully planned program of diamond drilling to prove the continuance of ore veins at depth will also be undertaken.

Mount Isa, Ltd., in collaboration with Zinc Corporation, is investigating a prospecting area of 75 square miles in Queensland. Mount Isa represents the biggest single American capital stake in Australian mining. The mine is also completing work on its No. 2 ore shaft.

Australia will no longer be an importer of refined copper when the Mount Isa mine gets its expanded copper concentrating mill and new reverbatory furnace into production. The plant's annual output of 15,000 tons will outstrip that of each of the two other major producers—Mount Lyell with 12,000 tons and Mount Morgan with 5,000.

Mount Isa started the sintering and smelting of copper in 1943 to meet the urgent war demand, but shut the smelter down after the war and concentrated on lead-zinc ore again. During the peak years, 1944 and 1945, Mount Isa produced concentrates of more than 15,000 tons of copper content, and about 12,000 tons of blister copper were produced during each of these years. Australian production is currently running about 20,000 tons of refined copper a year.

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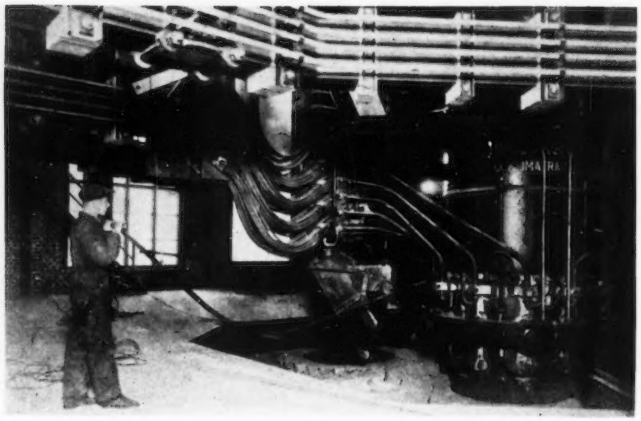

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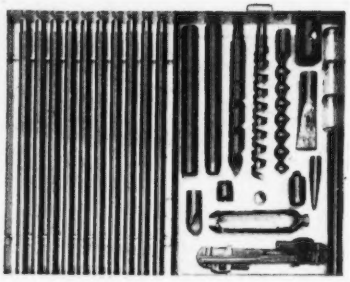

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Australia *(Continued)*

Titanium & Zirconium Industries Pty., Ltd.—Lured by the double promise of radioactive thorium and of up-and-coming titanium, the Barrier lead-zinc companies are displaying considerable activity on Queensland beaches through a subsidiary, Titanium & Zirconium Industries Pty., Ltd. This firm holds leases of 30 square miles on North Stradbroke Island and of 15 square miles on Moreton Island. A treatment plant with a capacity of 10,000 tons of titanium concentrate a year has been completed. Many other claims and dredging leases have been granted to minor concerns.

Australian Titan Products, Ltd., a subsidiary of British Titan Products, Ltd., started production of titanium pigments early this year from Indian ilmenite. The plant is located at Heybridge, near Burnie, Tasmania.

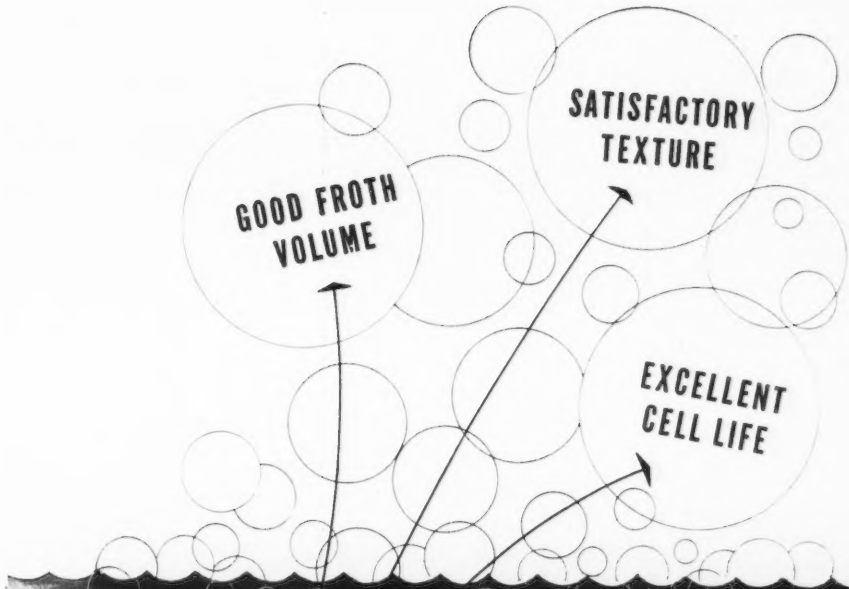
Australia gives away more sulphur in exported ore concentrates than it imports as elemental brimstone at a great expense of scarce dollars. However, this paradox should be resolved during the next few years as recovery of sulphur and sulphuric acid in roasting processes is steadily gaining ground, conserving one of the vital base materials of chemical industry. At Risdon, the Electrolytic Zinc Co. has completed construction of a sulphuric acid plant which it believes to be the biggest in the Southern Hemisphere. It operates in conjunction with the flash roaster. Gases from the roaster contain about 8% sulphur dioxide.

One of the world's lowest-grade big copper mines is being kept profitably in operation at Mount Lyell, Tasmania, by keeping mechanization of the open cut abreast of rising labor costs. Installation of a 84x60-in. jaw crusher alone has increased tonnage per man-shift by 15%, reduced secondary blasting by 60% and stepped up the net shoveling rate by 5 to 10%.

PHILIPPINES — Lepanto will double mill capacity. War damaged mines are rebuilding.

Benguet-Balatoc—April production established another postwar record, with 46,644 tons milled valued at $316,250 at the statutory price, averaging $6.77 per ton. Operations continue normal. Benguet engineers have been examining and sampling the mine workings of the Baguio Gold, with the possibility that Benguet may take over the latter on an operating contract or a royalty basis. Before the war Baguio Gold was one of the more important gold producers in Mountain Province.

Negotiations are also proceeding between Benguet and Marsman interests regarding possibility of milling Itogon ores in the Benguet central mill. The



"Yarmor" F Pine Oil is ... the ideal frother for the ... of sulphide minerals, such as zinc ... lead sulphide . . . and for non-sulphide minerals, such as coal, mica, quartz, graphite, feldspar, phosphate rock, talc. "Yarmor" F is especially desirable ... heavily mineralized froth is required, ... since it can support and hold heavy concentrations of minerals until they are removed from the flotation circuit.

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SULPHIDE AND NON-SULPHIDE MINERALS

HAVE YOU TRIED THIS NEW COLLECTOR?

Hercules Rosin Amine D provides a relatively new cationic flotation reagent—an excellent collector for silica and siliceous minerals. It can be used to beneficiate many non-metallic and oxide ores, such as feldspar, phosphate rock, cement rock, and iron ore. Write for details.

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● CARLON E Flexible Pipe is the most economical solution to your corrosion problems. It is furnished in long length coils, requiring few fittings. Flexibility permits turns without ells and also conforms to irregular ground surfaces.

Resistant to practically all inorganic chemicals Carlon E Pipe is immune to electrolytic corrosion and will not form a galvanic couple.

Carlon E Flexible Pipe is practically unbreakable. Its high impact resistance is maintained at temperatures 70° below zero to 140 F. Carlon E Flexible Pipe is available in ½", ¾", 1", 1¼", 1½", 2", 3" diameter in coils and 4" and 6" sizes diameters in straight lengths, through strategically located distributors and direct from factory stock.

SPECIAL TRIAL OFFER

Carlon E is furnished in 200 ft. coils for easy handling. To enable you to give it a practical trial in your mine we will furnish one coil of the 2" size at the 2000 ft. quantity price of 40c per foot or $80.00 on condition that if it does not prove entirely satisfactory within one year it can be returned for full credit. *ORDER TODAY.*

Write for quantity prices and full information.

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Philippines *(Continued)*

Itogon, formerly second only to Benguet-Balatoc in value of its production, has been idle since the war. Its surface plant was wholly destroyed by aerial bombardment. Ralph Crosby, formerly in charge of Marsman mines in the Baguio field, is now assistant to J. S. Peterson, general superintendent of Benguet-Balatoc mines.

Coco Grove, most important prewar gold dredging operation in the Philippines, has received $253,500 as a preliminary payment on its war damage claim. It is estimated it will cost about $400,000 to repair the one remaining dredge and bring it back to its prewar capacity of 185,000 cu. yd. per month, but assurance is given that initial work is under way. It is expected that payments will also be made to United Paracale and San Mauricio and plans are being formulated to rehabilitate these mines when the funds are received. While heavily damaged during the occupation years, both mills are standing with considerable equipment intact.

Acoje—April shipments totaled 7,000 tons with a total value of $119,000. According to the annual report of the company, positive and probable ore reserves amount to 280,000 tons, but it is believed this figure by no means represents the potential undeveloped ore in the property. A new ore-buying contract for the output of the mine has been signed with E. J. Lavino & Co. L. W. Shaner, mine manager, stated that in the near future the company expects to design and install a concentrating plant for the very large bodies of low-grade ore known to exist on the property. Additional large capacity compressors will be required for more underground work as well as a larger power plant.

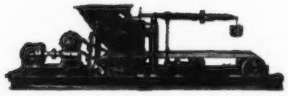
Lepanto Consolidated—It is announced that plans have been made to expand mill capacity to 1,000 tons per day and bids for the necessary equipment have been requested. The program will probably require 12 to 18 months to complete. Production for 21 days in April totaled 1,506 tons of concentrates, containing 27.9% copper and 1.22 oz. gold per ton.

Surigao Consolidated—The new Allen shaft should be completed in August to the 500-ft. level. This will permit production to be increased to prewar capacity of 400 tons per day. Good results are reported from development on the 400-ft. level.

Manganese ore is in good demand from American buyers, but production is limited. Examination has been made of deposits in Northern Luzon. Tonnages are small but the ore is good.

Philippine Iron Mining Co. has made four shipments of ore to Japan totaling 27,465 tons, and Samar Mining Co. shipped 15,750 tons in March. A stockpile of 60,000 tons will be utilized for further shipments this summer.

Personal News on Page 206



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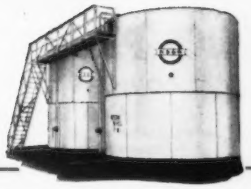

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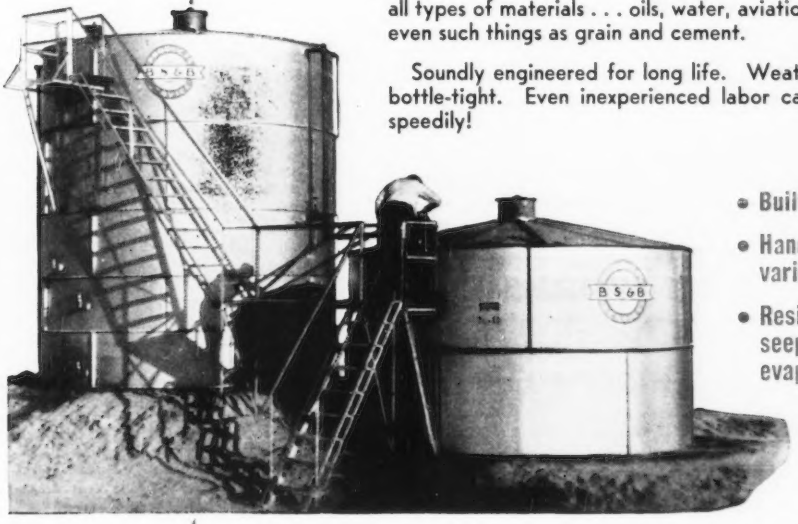
. . . easily transported, simple to erect and take down for re-use again and again!

Yes . . . here's the tank that can go wherever you can go. Knocked down, a large one is only a truck load. Many a time they have been flown in to a new operation.

But there is much more to B S & B Bolted Steel Tanks than their portability. They have proved their ability on all types of materials . . . oils, water, aviation gasoline . . . even such things as grain and cement.

Soundly engineered for long life. Weather-proof and bottle-tight. Even inexperienced labor can erect them speedily!



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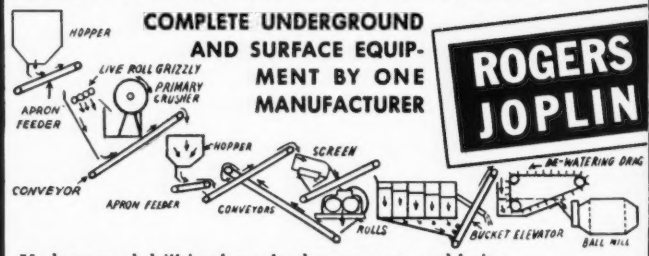

Underground drill jumboes, loaders, scrapers and hoists . . . surface equipment from hopper to ball mill . . . co-ordinated equipment, all from ROGERS. This assures smooth, balanced operation, less maintenance and single responsibility . . . advantages that reduce production costs.

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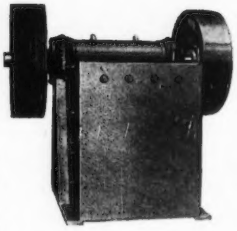
Smooth operating, *and fast!* Primary crushers in six sizes, 15 x 24 to 32 x 40; secondaries in twelve sizes to meet any requirement, 5 x 6 to 10 x 36. Design is backed by over 40 years of crusher building experience . . . *it's right!*



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JOPLIN, MISSOURI

Personal News

William A. M. Burden, The American Metals Co., Ltd., was elected a director on June 8, to fill the vacancy caused by the resignation of **Arthur D. Storke. Herbert Cohen,** assistant treasurer of the company, was elected comptroller.

Leigh Jones has been appointed manager of the industrial sales branch office, Western Machinery Co., Denver, Colo. Following his graduation from the University of California as a mining engineer in 1938, he joined Western Machinery as a sales trainee in mining and contractors equipment sales. Since that time he has worked in both the mining and construction machinery fields.

L. H. Lange, vice president and consulting metallurgist, The Galigher Co. of Salt Lake City, sailed June 15 from New York City on the S.S. Robin Hood for South-West Africa. After spending several months at Tsumeb, he will spend some time visiting Johannesburg and the copper properties in Northern Rhodesia.

Paul M. Tyler, consultant on minerals for the Joint Congressional Committee on Foreign Economic Cooperation, sailed on June 4 for Europe where he will spend several months studying the operations of the Marshall Plan.

Ward Carrithers, geologist, was recently transferred from Howe Sound Co., Chelan Division, to the Calera Mining Co., Forney, Idaho. **Elton Youngberg** succeeds him. **Ramon Fernandez** has been appointed mine foreman at Minerales de Chihuahua, S. A. El Carmen mine.

Andrew Fletcher, president, St. Joseph Lead Co., received the degree of Doctor of Engineering, Honoris Causa at the University of Missouri School of Mines, Rolla, Mo., on May 31. At that time he delivered the commencement address.

Dr. Morris M. Leighton, chief of the Illinois State Geological Survey, has been elected president-elect of the Society of Economic Geologists for the annual term 1950-51. He taught geology at several universities before joining the survey 25 years ago.

Dr. Karl T. Compton, chairman of the Research and Development Board of the National Military Establishment and chairman of the Corporation of Massachusetts Institute of Technology, has been elected a director of McGraw-Hill Publishing Co.

T. P. Billings, manager of western mines for U. S. Smelting, Refining & Mining Co., has been made consulting mining engineer for the company. **Arch G. Kirkland,** assistant manager of mines, succeeds him.

Frank R. Milliken, formerly with the experimental laboratory of Kennecott Copper Corp.'s Utah Division, has been named assistant manager of the MacIntyre development unit of National Lead Co., titanium division.

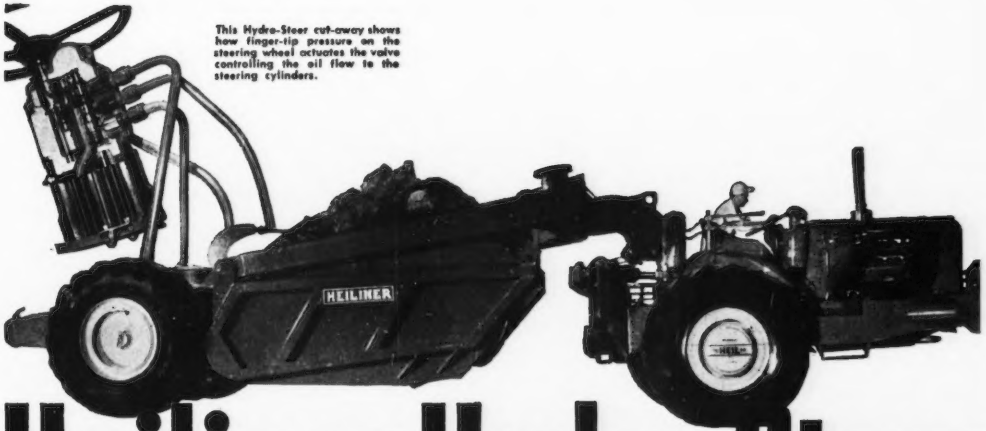
Lewis P. Larsen, president of Pend Oreille Mines & Metals Co., was awarded a certificate of merit by the Washington Institute of Technology at the 53rd annual commencement program of Washington State College on May 29.

Sherman B. Hinckley, of Salt Lake City, has been named president of Rico Argentine Mining Co. to succeed **C. T. Van Winkle,** who retired recently. He has served as general manager of mining and milling operations at the Rico, Colo., operations of the company for the past year.

Miles Standish, electrical superintendent of Northwest Magnesite Co., Chewelah, Wash., retired June 1, after 26 years with the company. **Gordon J. McCulloch** succeeds him.

CORRECTION:

R. W. Lauterwasser, chairman of the governing board of the San Francisco Mining Exchange and a copartner of Lauterwasser & Co., brokers, was elected a director of Central Eureka Mining Co. at that company's annual meeting in April. Through error Mr. Lauterwasser's name was omitted from the list of new directors for Central Eureka published by *Engineering & Mining Journal* last month.



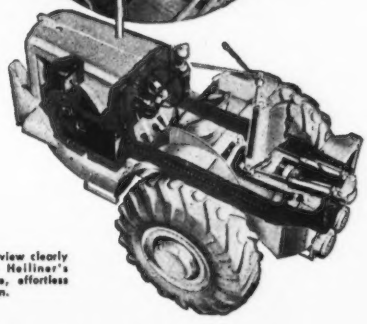
This Hydro-Steer cut-away shows how finger-tip pressure on the steering wheel actuates the valve controlling the oil flow to the steering cylinders.

Heiliner Hydro-Steer

the right steer to larger earthmoving profits

This husky heavy-duty hitch permits complete freedom of movement between the 2-wheel tractor, and scraper. Mechanical stops prevent over-steering.

The Hydro-Steer lets your operator turn the 39-foot Heiliner in a 22-ft. radius. And, he can do it with one hand.



This phantom view clearly illustrates the Heiliner's safe, positive, effortless steering system.

1. Because the Heiliner's patented hydraulic pump delivers a constant volume of oil, regardless of engine rpm — for safe, positive steering at all times.

2. Because your operator can handle a fully loaded Heiliner (wt. 45 tons) with passenger-car ease, maneuver quickly for faster cycles, move more dirt.

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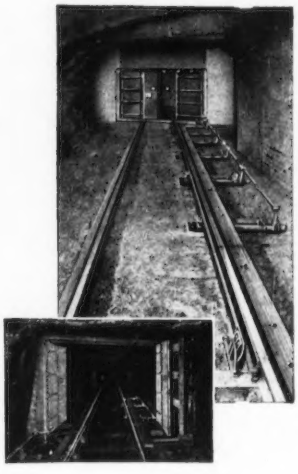
loads entire train on a single track ... pulls it out all at one time.

"Canton" Car Transfer

This famous economy device can be installed on any track of minimum gauge and rail now in use. Its operation is simplicity itself—pushing empty car on track by locomotive, then moved by hand to transfer section, permitting locomotive and cars to pass. Two men in two minutes can take down, to move the three units to new location when desired ... no alterations required for track or rails. Timken Roller Bearings enable easy shunting of heavy cars to maximum weight of 6 tons. The Car Transfer speeds up loading, haulage, saves expensive double-tracking.

More Air Where Wanted... Less Gas... Safety With "Canton" Automatic Doors!



Engineered flow of air sweeps out gas pockets, and air flow must be continuous, reliably directed by "Canton" Automatic Doors. Dissipating explosive air is one important function. Providing healthy, breathable air is another function that steps up productivity of every worker. Eliminating that trapper boy accident is another.

Insurance against accidents, increased haulage, continued speed ahead with "Canton" Automatic Doors make it imperative that every mine owner and manager investigate the economy proven by a quarter century of American Mine Door service.

"CANTON" DOORS ARE SELF LIQUIDATING IN A SHORT PERIOD

Note the photos... when the oncoming train rides the trip levers... flip, the doors open; when the last car passes... release, the doors spring shut... positive action and reaction... all mechanical in split seconds. Complete literature sent on request, engineering advice given without obligation. When writing, please use street and zone number.

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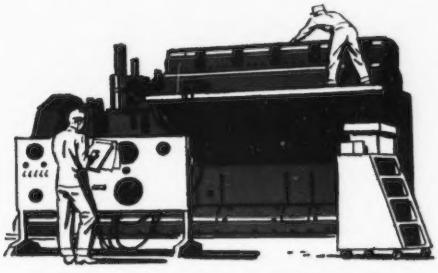
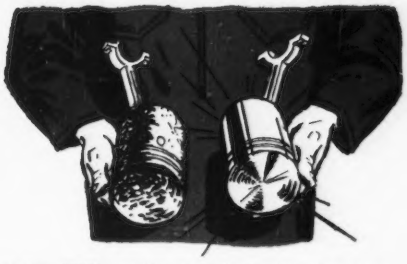
T5X SUPERIOR LUBRICATION FOR ANY INTERNAL COMBUSTION ENGINE!

T5X gives greater protection to any type of internal combustion engine in any industrial operation. Here are the reasons why:

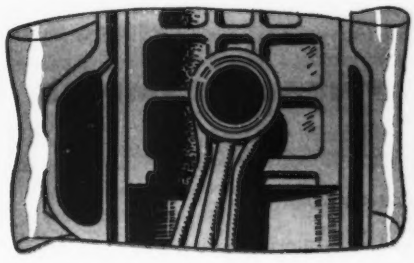


FIRST, T5X is a 100% pure, paraffin-base oil obtained from selected base stocks. It's a fully compounded, detergent-type oil that contains special rust and corrosion preventives.



SECOND, T5X contains an exclusive detergent compound that retards sludge formation to a remarkable degree. That means cleaner ring grooves, oil lines and pistons.

THIRD, T5X reduces wear to the minimum! A special inhibitor retards oxidation and gives high heat stability. A neutralizing agent combats acidity. Another ingredient suppresses foaming.



FOURTH, T5X forms an enduring oil film that gives maximum protection against scuffing and seizure. Rust and corrosion are held to a minimum by this tough film.

For full information on T5X phone your local Union Oil Representative or write Sales Dept., Union Oil Company, Los Angeles 14, Calif.

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OF CALIFORNIA

*T5X gets its distinctive color from an exclusive ingredient that helps give the oil its remarkable stability.

Less pounds of wear...

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NI-HARD CASTINGS

Ni-Hard* provides spectacular resistance to wear and abrasion... its Brinell hardness ranges from about 600 when sand cast, to as high as 700 when chill cast.

One of the hardest engineering materials ever developed for the mining industry, this nickel-chromium iron assures long, trouble-free life of cast parts. Use of Ni-Hard lowers maintenance expense and production costs by decreasing downtime for repair or replacements.

Castings of various designs may be produced with this reasonably priced nickel-chromium iron. Try Ni-Hard on *your* jobs involving severe abrasion. It is available from coast to coast. *Reg. U. S. Pat. Off.

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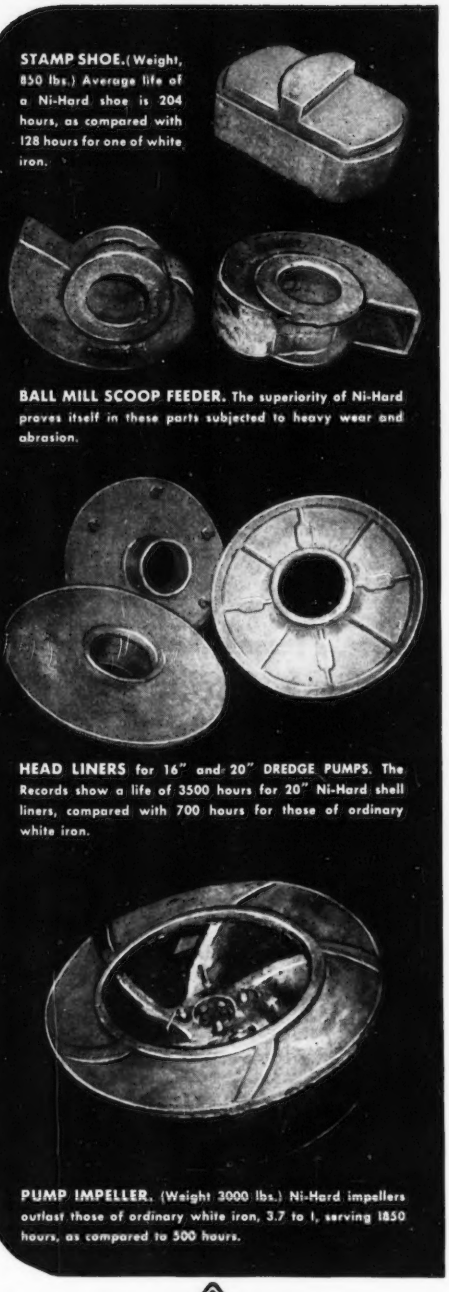
Performance of Ni-Hard in service of Calumet & Hecla Consolidated Copper Co., Calumet, Mich.



STAMP SHOE. (Weight, 850 lbs.) Average life of a Ni-Hard shoe is 204 hours, as compared with 128 hours for one of white iron.

BALL MILL SCOOP FEEDER. The superiority of Ni-Hard proves itself in these parts subjected to heavy wear and abrasion.

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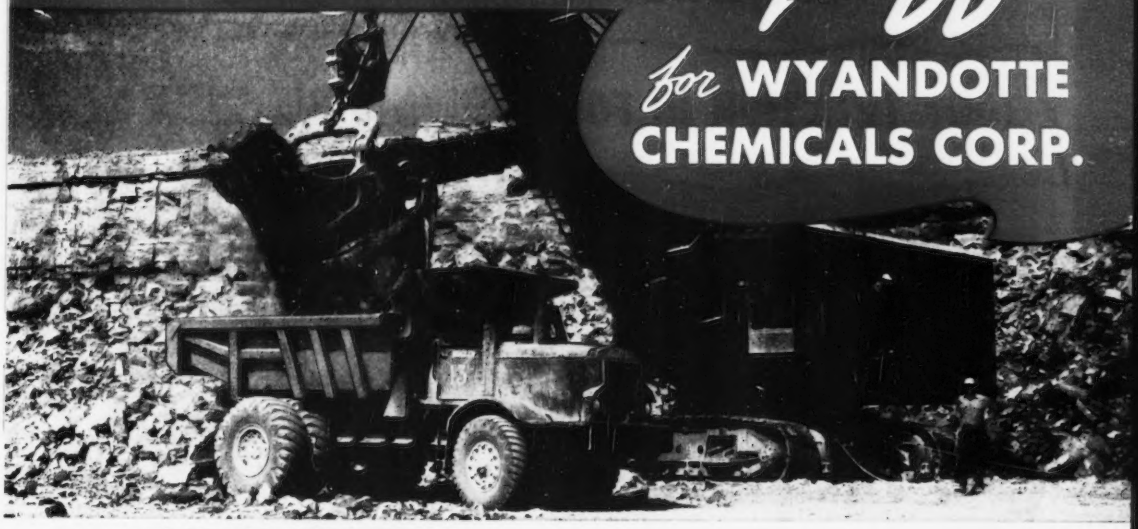

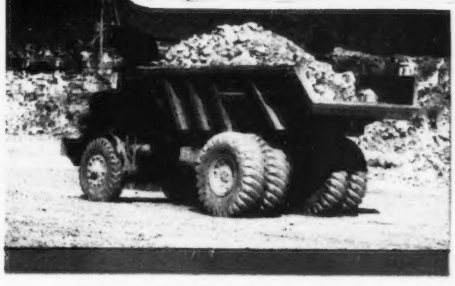

At Alpena, Mich., Wyandotte Chemicals Corporation operates one of the world's largest limestone quarries — another job where "Eucs" are paying off by doing more work at less operating and maintenance cost.

Thirteen Rear-Dump Euclids of 22-Ton capacity replaced an electric haulage system for moving the rock from quarry to plant. Operating two shifts per day and six days per week, the "Eucs" haul approximately 800 tons per hour. The round trip averages 1¾ miles, with a maximum grade of 4 per cent. The "Eucs" are loaded with stone by shovels of 5 and 6 yd. capacity, and are used for removing overburden during winter months.

Wyandotte standardized on Rear-Dump Euclids because of their proved dependability and efficiency in mine and quarry operations. Their large capacity and fast travel speeds have increased production and lowered hauling costs at Alpena.

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100% TRACTION IN FOUR DRIVING WHEELS!

300 hp. Walter Tractor Truck, with 40-ton side dump ore trailer.

- ★ Gets more Haulpower out of every horsepower
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WALTER Tractor Trucks give you not merely two, but *four* driving wheels—and not merely a four wheel drive, but the famous Walter 4-Point Positive Drive.

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Profit from the high tonnage and high availability of Walter Tractor Trucks at your mine. Write for literature giving full details on the construction and advantages of Walter Tractor Trucks.

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4-POINT POSITIVE DRIVE
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200 hp. Walter Tractor Truck, with 20-ton back dump body.

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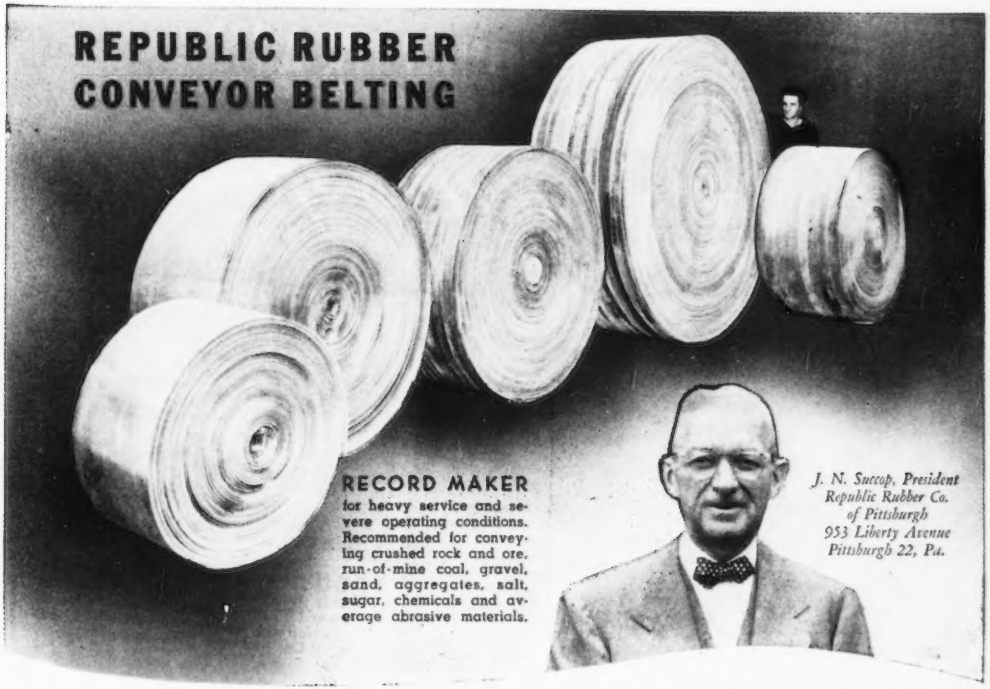
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CONVEYOR BELTING
RECORD MAKER
for heavy service and severe operating conditions. Recommended for conveying crushed rock and ore, run-of-mine coal, gravel, sand, aggregates, salt, sugar, chemicals and average abrasive materials.
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The best heavy service Conveyor Belt Republic ever built!

● Mr. Succop, pictured above, will tell you that from his experience price is not a good yardstick for economy. It is the long service life of conveyor belting that reduces costs. "You can save money," says Mr. Succop, "by choosing a type and grade of belt built especially to carry the material you move."

Republic Rubber constructs Record Maker belting with standard, soft woven belt duck in weights and plies determined by your load conditions and other service factors. Cover thicknesses vary accordingly. A breaker strip may be specified, and straight or step-ply construction is optional. Record Maker has earned an enviable reputation by delivering exceptional service on severe applications the world over.

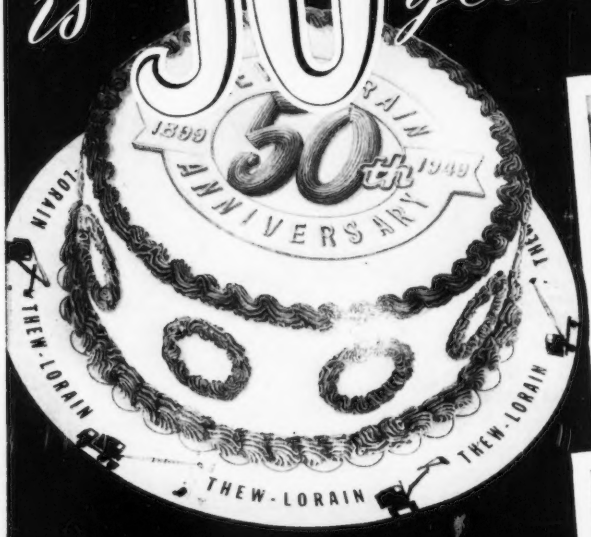
If you want conveyor belt economy consult your telephone directory for the name of your Republic distributor, write or mail the coupon.

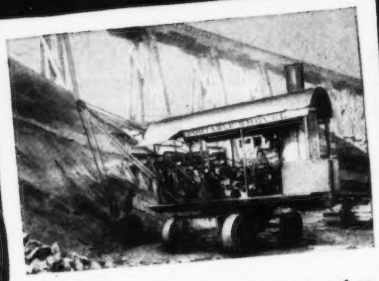
REPUBLIC RUBBER DIVISION

REPUBLIC RUBBER DIVISION
Lee Rubber & Tire Corporation, Youngstown, Ohio
Lee Deluxe Tires & Tubes Conshohocken, Pa.

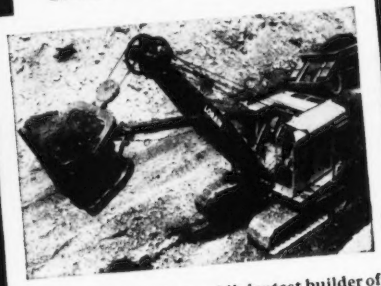
WHO REPRESENTS REPUBLIC IN MY AREA?
REPUBLIC RUBBER DIVISION · LEE RUBBER & TIRE CORPORATION
YOUNGSTOWN, OHIO
Name, title_____
Firm_____
Address_____
City_____ State_____

THEW-LORAIN is 50 years young!





1899 . . . First full revolving shovel as designed and built by Captain Richard Thew in 1895. After 4 years of operation as a private business, The Thew Shovel Co. was incorporated in 1899.



TODAY . . . The world's largest builder of commercial size shovels, cranes, clamshells, draglines and hoes, mounted on crawlers or rubber-tires, is identified by the trademark "Thew-Lorain."

50 years ago — July 17, 1899 — an idea became an industry — an industry still going strong today as The Thew Shovel Co. Thew alone hasn't made this anniversary possible. It's due largely to you and your repeated confidence in Thew-Lorain products. We're old only in our years of experience and "know-how" . . . but young as ever in our ideas and efforts to serve you better, today and tomorrow.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW-LORAIN 1899 50th 1949 ANNIVERSARY

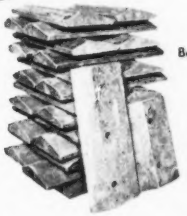
50 YEARS devoted exclusively to the design and manufacture of Power Shovels & Cranes.

THEW Lorain

Trends in mining constantly change but this fact remains...

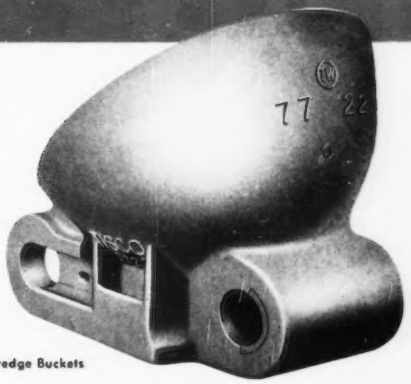
TISCO MANGANESE STEEL

outwears all steels under severe impact and abrasion!



Ball Mill Liners

Dipper Teeth

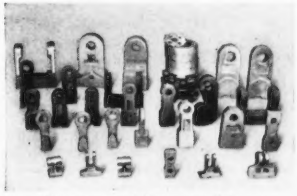


Dredge Buckets

SINCE 1892, when Taylor-Wharton poured the first heat of Hadfields Manganese Steel in America, this tough, work-hardening steel has proved its superiority for wear parts in digging, dredging, crushing, grinding, pulverizing, conveying and other equipment subjected to heavy abrasive wear.

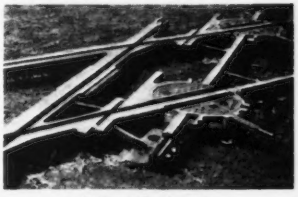
Taylor-Wharton has had longest experience in this country in melting, pouring, heat-treating, grinding and inspecting manganese steel—and in its practical application under every possible condition. TISCO Manganese Steel is produced in the most modern electric furnaces, under constant supervision of experienced metallurgists. All TISCO castings are carefully designed for best foundry practice and proper heat treatment, made to accurate analysis, held to accurate dimensions. This combination assures longer wear, fewer breakdowns, lower cost in your severe-service operations.

To get these advantages, be sure to specify the name TISCO when ordering new equipment or replacement parts from your supplier. Engineering cooperation gladly given.



Pulverizer and Hammermill Parts

Jaw Crusher Parts



Railroad Trackwork

Taylor-Wharton Iron and Steel Co.

High Bridge, N. J. Easton, Pa., U. S. A.

Cable Address: TISCOSTEEL, Washington, N. J.

Offices in: New York Pittsburgh San Francisco Los Angeles
Charleston, W. Va. Detroit Chicago Baltimore Seattle

Represented in London, England; The Hague, Holland; Malaya and Netherlands, East Indies

TISCO *first in* MANGANESE STEEL

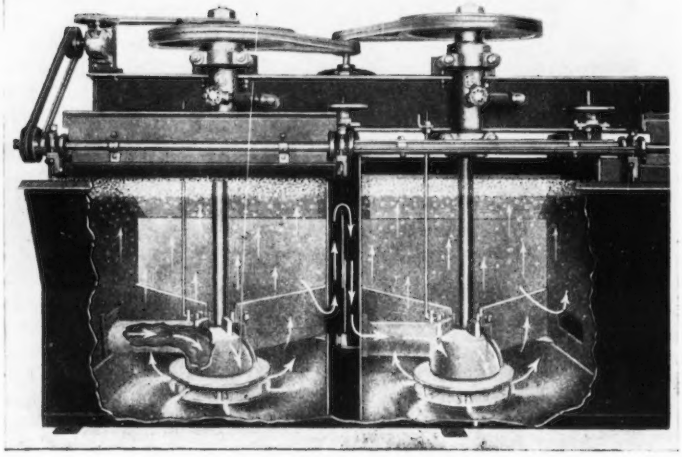
FOUNDED TW 1742

GOOD NEWS FOR YOU

"Jetair" Flotation

FOREMOST FOR ALL FLOTATION PURPOSES

A major advance in uniform and controlled air introduction—more thorough and efficient mechanical agitation combined with new "Jetair" principle that gives most complete air dispersion ever attained. Mechanical simplicity and highest metallurgical efficiency in least flotation time.

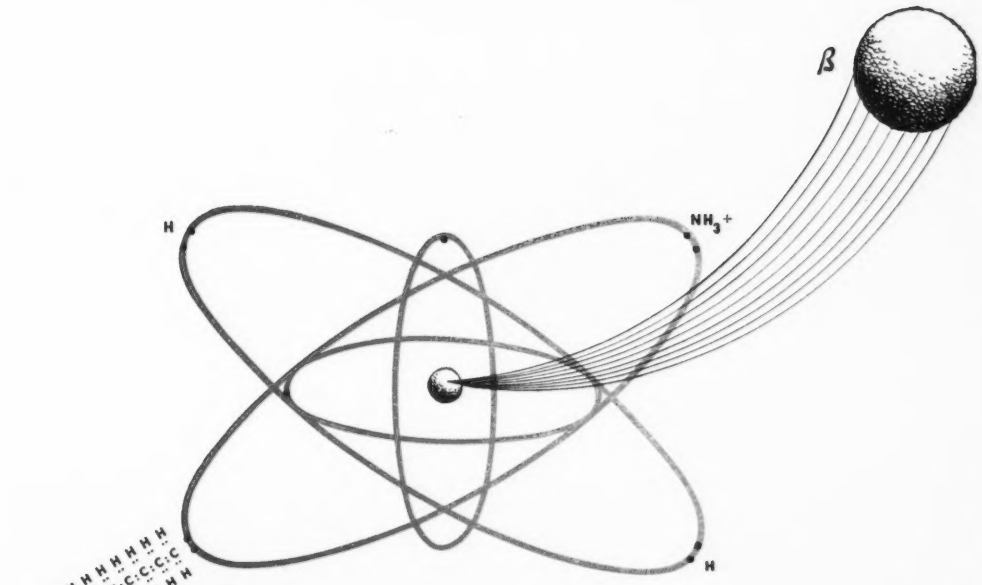


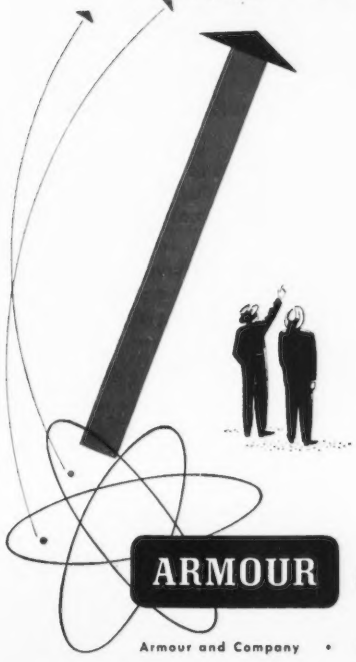
BULLETIN NO. 482 UPON REQUEST

MORSE BROS. MACHINERY CO.

ESTABLISHED 1898

P. O. BOX 1708 • DENVER, COLORADO, U. S. A. • CABLE "MORSE"





Froth Flotation—the mining industry's most versatile method of concentrating both metallic and non-metallic minerals—long has been the subject of intensive Armour Chemical Division Research.

Today, this research is centered on the use of radioactive flotation reagents—which reveal the composition of the mineral-organic film mechanism with amazing accuracy.

After synthesizing the radioactive flotation reagents—n-dodecyl amine and lauric acid—containing radioactive carbon 14, utilization of these new tools was entrusted to Massachusetts Institute of Technology with a grant from the Chemical Division of Armour and Company.

Unlike metallurgical chemicals in the early days of non-metallic mineral concentration, Armour's Armeens, Armacs, Arquads, and Neo-Fats are made to order for flotation use. The mineral-dressing engineer knows the formula, composition and constants, molecular weight, melting point, percent purity, etc. of Armour flotation chemicals. Only with complete knowledge can he get the most out of your research dollar.

The Armour Chemical Division asks only the opportunity of helping you to use our present extensive range of cationic and anionic flotation reagents, and to offer our basic knowledge in chemical research to help you find the reagent you need.

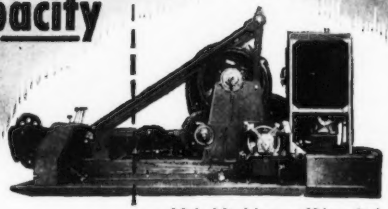
For the present, we propose to offer you the answers to these questions: Where does the flotation reagent go? How much is used effectively? How much is in the tailings water? What influences the reagent to shift from one mineral to another?

For the future, we offer you the benefits of our continuing research.

ARMOUR *Chemical Division*

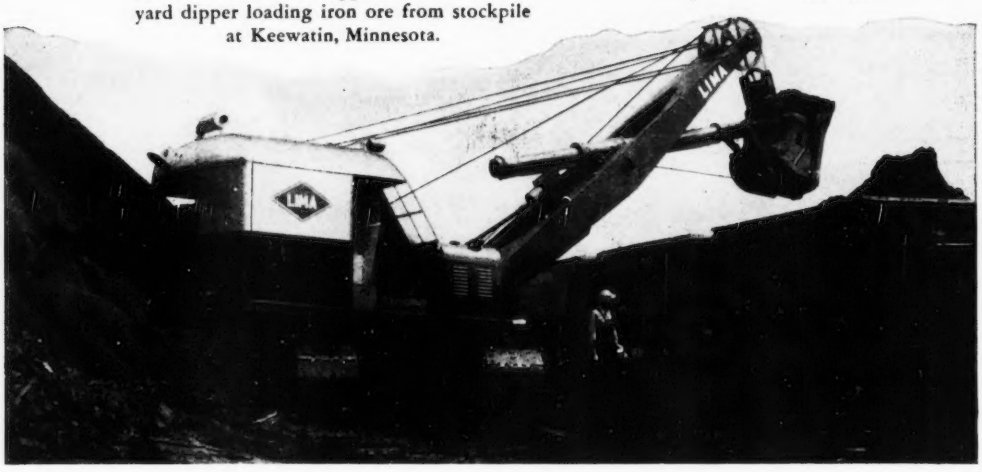
Armour and Company • 1355 West 31st Street • Chicago 9, Illinois

Why the LIMA Type 604 develops the greatest capacity per lb. of weight



← Main Machinery of Lima 604. Dotted line shows center of rotation.

Lima Type 604 Shovel equipped with 23 ft. boom, 18 ft. dipper handle and 1½ yard dipper loading iron ore from stockpile at Keewatin, Minnesota.



● The LIMA Type 604 shovel, crane and dragline is engineered to produce greatest capacity with minimum weight. This is achieved by placing as much weight as possible *behind* the center of rotation—eliminating the need for excessive counterweight. Hook rollers on which the machinery base revolves eliminate strain from the center pintle—permitting continuous, safe operation at full capacity.

The simple, compact design of the main machinery, using the fewest number of shafts to accomplish the various operations, further contributes to efficient, trouble-free service.

These are only a few of the features which make the LIMA 604 a favorite with owners and operators. The Lima Line includes shovels ¾ to 6 yards, Cranes 13 to 110 tons and Draglines variable.

It will pay you to consult your nearest Lima Sales Office or representative before you buy your next shovel, crane or dragline. Offices in principal U.S. cities.

Lima Shovel and Crane Division

LIMA, OHIO

LIMA HAMILTON CORPORATION

OTHER DIVISIONS: *Lima Locomotive Works Division; Niles Tool Works Co.; Hooven, Owens, Rentschler Co.*

Two-Stage CUTTING ACTION

1 THE PILOT CUTS
2 THE WINGS CUT

NOW THE NEW

Liddicoat

DETACHABLE

DRILL BITS

FOR FASTER, LOW COST DRILLING

"Used to Destruction and Discarded . . . No Resharpening"

The Liddicoat bit has been developed and proven in Canadian mines where it has been in use for many years. Its outstanding performance in drilling, the simplicity of the connection, and the low cost of the Liddicoat bit, have made it the most widely used detachable bit in Canada today. Since its recent introduction into the United States it has rapidly gained popularity and has been adopted by some of the largest and most important mining and construction companies in America.

The Liddicoat detachable drill bits are manufactured in three modern plants. Calumet and Hecla Consolidated Copper Company has been licensed to manufacture and sell exclusively in the 37 eastern states and Western Rock Bit Manufacturing Company for the 11 western states, Alaska, Hawaii and the Philippine Islands. These plants, together with Thompson Products Ltd.'s plant at St. Catharines, Ontario, are equipped with the most modern high-production rock bit manufacturing facilities yet developed.

Types Available:

Liddicoat bits are made with several types of connections which make them adaptable for use with all conventional steel sections. Gauge sizes are varied so that the selection of bits can be made for any rock condition. Wing and gauge designs allow full advantage to be taken of the modern automatic machines with their long shells. Special gauge sizes can be made for individual requirements.

FIELD AND ENGINEERING *Service*

Field service departments staffed by experienced mining engineers are maintained to assist operators in all phases of Liddicoat bit usage. We welcome every opportunity to be of assistance whatever your drilling problem may be.

Manufactured by
CALUMET & HECLA CONSOLIDATED COPPER CO.
CALUMET, MICHIGAN
Suppliers to 37 Eastern States

WESTERN ROCK BIT MFG. CO.
552 WEST SEVENTH SOUTH STREET
SALT LAKE CITY, UTAH
Suppliers to 11 Western States

WR ROCK

El-Tronics INC.

FINEST "IN THE FIELD!"

GEIGER MÜLLER

Portable

SURVEY INSTRUMENTS

URANIUM ORE

MODEL SM3

Here is the finest portable survey instrument made for tracking down elusive uranium ores. Of lightweight welded aluminum construction it weighs only 8¾ pounds, is completely waterproof and can be carried anywhere. A self-contained Geiger-Muller counter tube probe unit attached to the instrument by a 30" cable makes taking measurements in crevices and confined places an easy matter. Radiation intensities can be read in a few seconds directly from the indicating meter. Its three full scale ranges detect the most sensitive impulses, with instantaneous accuracy. Backed by 14 years of design experience, the SM3 is ideally suited to rugged use in the field without sacrificing any of the delicate sensitivity of laboratory equipment.

Outstanding Features:

- Battery life in excess of 200 hours
- No Tools necessary to replace batteries
- Instantaneous readings directly from scale of 3" meter
- Uses standard miniature type radio tubes
- Counter tube sensitive to both Beta and Gamma radiation
- Complete and ready for operation **$225**

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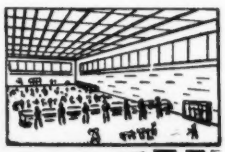
America's Foremost Crafters Of Scientific Equipment

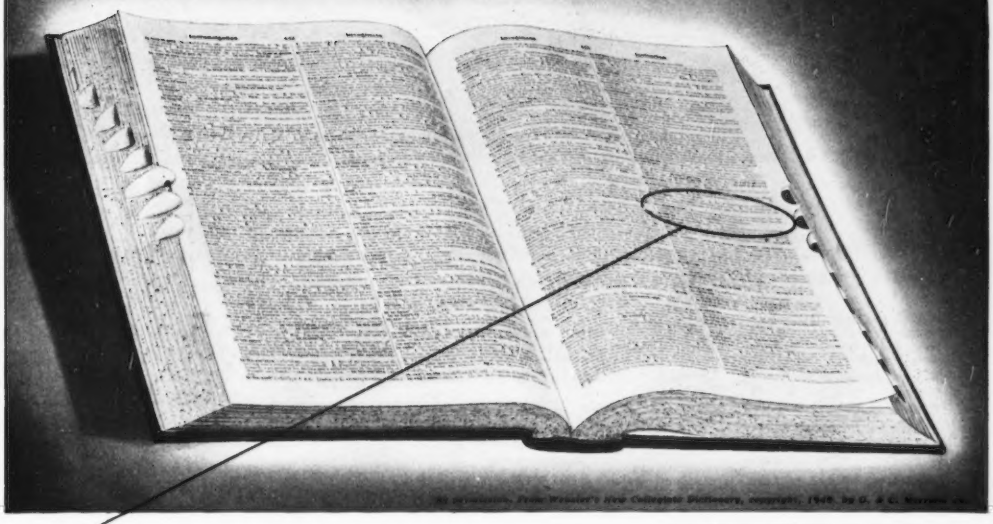
A COMPLETELY EQUIPPED PRECISION ELECTRONICS PLANT TO SERVE YOU

El-Tronics offers unexcelled production facilities for the manufacture and assembly of precision electronic equipment of all kinds. Our plant offers excellent tooling, skilled engineering and highly trained craftsmen. Call on us for a discussion of your requirements.



Why We Say

CHEMICO PLANTS ARE PROFITABLE INVESTMENTS



Webster defines an investment as "the investing of money or capital for income or profit." In the heavy chemical field, Chemico is a proved translator of *investment* into profit. Here's why:

Every Chemico-built plant is planned and designed to fit individual needs.

Each plant is designed by engineers and technologists of recognized authority.

Chemico's advanced processes and selection of equipment insure high efficiency of operation...and, where necessary, new processes and facilities are developed to meet special circumstances.

Chemico brings to bear on each new project its 35 years of experience in constructing a wide range of heavy chemical installations.

Chemico turns the plant over to the purchaser only after over-all performance guarantees have been met. But initial performance is not enough. Chemico also trains the client's staff in every phase of operation.

Chemico takes full responsibility for the job... from initial investigation to completed project.

These are some of the reasons why owners have found that "*Chemico Plants are Profitable Investments.*"

Before deciding to build a new heavy chemical plant or remodel an old one, it will pay you to consult Chemico. CC186

Typical Chemico Undertakings

PLANTS FOR PRODUCTION OF

SYNTHETIC AMMONIA
SYNTHETIC METHANOL
DOUBLE SUPERPHOSPHATE
AMMONIUM PHOSPHATE
AMMONIUM SULFATE
AMMONIUM NITRATE
CALCIUM NITRATE
FORMALIN

PLANTS FOR PRODUCTION, CONCENTRATION AND RECOVERY OF

HYDROCHLORIC ACID
NITRIC ACID
PHOSPHORIC ACID
SULFURIC ACID

CHEMICAL CONSTRUCTION CORPORATION

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND

EUROPEAN LICENSEE OF N. E. C. PROCESS
HYDRO-NITRO S. A., 3 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND

CABLES: CHEMICONST, NEW YORK

CHEMICO CHEMICAL CONSTRUCTION

Chemico Plants are profitable investments

Easy as fixing a faucet

THE GRINNELL-SAUNDERS DIAPHRAGM VALVE has only one part that normally wears and needs replacement . . . the diaphragm. Depending on the type of service, it may last for years or only months. It can be replaced in just a few minutes. The valve body doesn't have to be removed from the pipe line . . . only the bonnet. The new diaphragm is attached to the bonnet which is then bolted back onto the valve body . . . and the valve is restored to service. That's all the maintenance a Grinnell-Saunders Diaphragm Valve normally needs. No packing glands to demand frequent attention. No refacing or reseating required, because there are no metal-to-metal seats to become damaged or wire drawn.

SIMPLE, POSITIVE OPERATION . . . Flexible diaphragm opens wide for streamlined flow, pinches tight for positive closure even when grit, scale or other solid matter is trapped on the weir.

NO CLOGGING . . . MINIMUM RESISTANCE TO FLOW . . . Smooth, streamlined fluid passage without pockets prevents accumulation of sludge and reduces friction resistance to a minimum.

NO CORROSION . . . NO CONTAMINATION . . . NO LEAKS . . . The working parts of the valve are completely isolated from the fluid by the diaphragm. Diaphragm materials, body materials and body linings are available to suit service requirements.

Available in various combinations of valve bodies and operating mechanisms. Write for catalog.

99 YEARS PIPING

GRINNELL

Grinnell Company, Inc., Providence, Rhode Island. Branches: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Call WHITE HAVEN (PA.) 4321 *for*
ANY SIZE OF RIVETLESS CHAIN

Wilmot Stocks All Specified Sizes: For 3,000 to 130,000 Lbs. Working Loads. Attachments Stocked for Every Purpose

For prompt shipment, we maintain in stock at White Haven, Pa., the largest selection of chain sizes available. See list below. As originators of "Keystone Rivetless" chain, we also stock the largest selection of elevator and conveyor attachments. Shipments in any quantity. File this sheet for ready reference.

A section of our stock of Keystone Rivetless Chain at White Haven, Pa.

STANDARD KEYSTONE RIVETLESS CHAIN

Made from Drop Forged Alloy Steels

CHAIN NO.	MATERIAL	APP'X PITCH	MAX. WK. LOAD	BREAK. POINT
348	EEE-Normalized	3"	3,500	18,500
348	EEE-Heat Treated	3"	4,500	24,000
348	3140-Heat Treated	3"	4,800	27,000
348	3240-Heat Treated	3"	6,000	31,000
458	EEE-Normalized	4"	8,000	37,000
458	EEE-Heat Treated	4"	10,000	47,000
458	3140-Heat Treated	4"	12,000	49,000
458	3240-Heat Treated	4"	13,500	53,000
468	EEE-Normalized	4"	17,000	95,000
468	EEE-Heat Treated	4"	28,000	106,000
468	3140-Heat Treated	4"	32,000	120,000
468	3240-Heat Treated	4"	36,500	130,000
678	EEE-Normalized	6"	16,000	70,000
678	EEE-Heat Treated	6"	20,000	81,570
678	3140-Heat Treated	6"	25,000	90,000
678	3240-Heat Treated	6"	30,000	100,000
688	EEE-Normalized	6"	28,000	110,000
688	EEE-Heat Treated	6"	40,000	124,000
688	3140-Heat Treated	6"	41,000	135,000
688	3240-Heat Treated	6"	50,000	154,000
698	EEE-Normalized	6"	18,000	120,000
698	EEE-Heat Treated	6"	28,000	137,500
698	3140-Heat Treated	6"	32,000	149,000
698	3240-Heat Treated	6"	36,000	170,000
998	EEE-Normalized	9"	18,000	120,000
998	EEE-Heat Treated	9"	28,000	137,500
998	3140-Heat Treated	9"	32,000	149,000
998	3240-Heat Treated	9"	36,000	170,000

CHAIN NO.	MATERIAL	APP'X PITCH	MAX. WK. LOAD	BREAK. POINT
9118	EEE-Normalized	9"	40,000	200,000
9118	EEE-Heat Treated	9"	60,000	223,000
9118	3140-Heat Treated	9"	70,000	250,000
9118	3240-Heat Treated	9"	76,000	290,000
9148	EEE-Normalized	9"	53,000	270,000
9148	EEE-Heat Treated	9"	80,000	300,000
9148	3140-Heat Treated	9"	92,000	345,000
9148	3240-Heat Treated	9"	104,000	375,000
105208	EEE-Normalized	10½"	70,000	350,000
105208	EEE-Heat Treated	10½"	110,000	395,000
105208	3140-Heat Treated	10½"	122,000	450,000
105208	3240-Heat Treated	10½"	132,000	495,000
105208	Cast Alloy Steel	10½"	128,000	460,000

EEE,listed above, is a special alloy steel made for Wilmot "Keystone Rivetless" chain. It is used for most stock chain because it proves superior in service on the majority of materials-handling applications. A substantial stock of chains made of alloy steels 3140 and 3240 is also maintained, although we do not assure ready shipment of all sizes. In addition to the above materials Keystone chain will be furnished in any alloy steel to meet your specific problems: corrosion, abrasion, temperature, load.

Send for
NEW 280-PAGE BOOK ON CHAINS
Conveyors, Elevators

WILMOT ENGINEERING CO.

HAZLETON, PA.
Plant: WHITE HAVEN, PA.

Wilmot Coal Preparation Equipment: Hydrotators • Hydrotator-Classifiers • Hydro-Separators • Simplex Jigs Crushing Rolls • Sizing Shakers • Bucket Elevators • Conveyors • Car Hauls • Keystone Rivetless Chain, etc.

WILMOT BUILDS BETTER BREAKERS

Are Your Operating Conditions UNUSUAL?

No Matter How Tough the Assignment, We Can Build

DAVENPORT
Better-Built
LOCOMOTIVES

to give you **LOW TON-MILE COSTS** *throughout a long Service Life . . .*

Are Your Altitudes Extreme?

Locomotive No. 4, below, operates at an altitude of 14,000 ft. We can meet your altitude demands.

Are Temperature Changes Drastic?

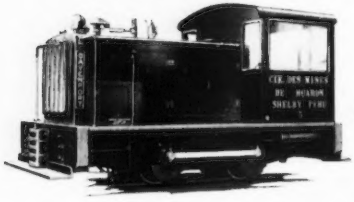
On the line from the Persian Gulf to the Caspian Sea, twenty-five Davenports are unbothered by variations from far above 100° to sub zero, F.

Is Your Trackage Uncertain?

Locomotive No. 2 Spreads weight over 8 drivers to protect light bridges or weak track. Locomotive No. 3 achieves safety at high speeds over uneven track by means of leading and following trailers.

Must Unit Operate Within Mine?

We supply power units for SAFE mine and tunnel operation, without cabs and equipped with flame arresting labyrinths and spray bath for cooling and to assist in eliminating noxious fumes. See Locomotive No. 1.



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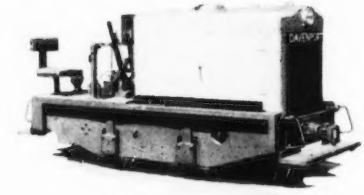

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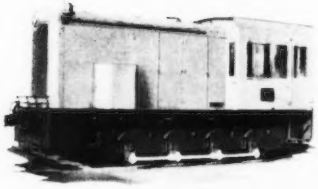

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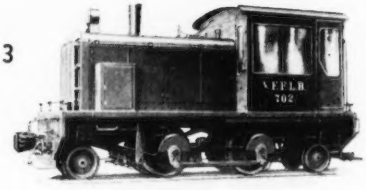

3

WE BUILD TO SATISFY YOUR REQUIREMENTS

FREE ANALYSIS OF OPERATING CONDITIONS

It will be a pleasure to send you our latest Haulage Survey Data Sheet to enable you to describe your operating conditions and work to be done. Our engineers, without obligation, will analyze the data you submit and recommend the size and type of locomotive that would give you BEST RESULTS.

Complete Information on Request

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A DIVISION OF DAVENPORT BESLER CORPORATION

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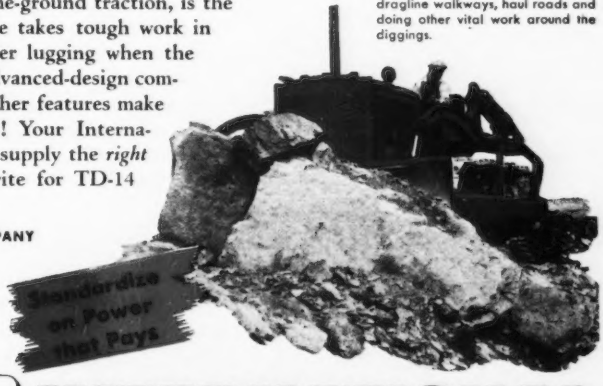
DAVENPORT LOCOMOTIVES • STEAM • GASOLINE • DIESEL • ELECTRIC OR MECHANICAL DRIVE

A glutton for punishment, powered by a diesel engine with matchless lugging ability and stamina—this is the tractor for you to use on heavy, back-breaking jobs. The International Crawler, with broad-gauge stability, balance and geared-to-the-ground traction, is the worker you need. ● Its powerful engine takes tough work in stride, with increased torque for heavier lugging when the load demands it. All-weather starting, advanced-design combustion, full pressure lubrication and other features make it *your* obvious choice among tractors! Your International Industrial Power Distributor can supply the *right* size with *matched* equipment, now. Write for TD-14 or TD-18 Folders.

INTERNATIONAL HARVESTER COMPANY
Chicago

Hear James Melton and "Harvest of Stars" every Sunday — NBC

An International TD-14 Diesel puts these rocks in their place with its hydraulic blade before building dragline walkways, haul roads and doing other vital work around the diggings.



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DIESEL ENGINES
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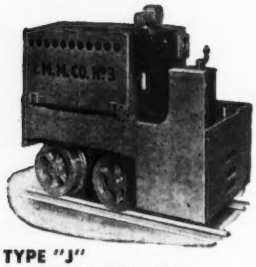
INTERNATIONAL INDUSTRIAL POWER

ATLAS LOCOMOTIVES

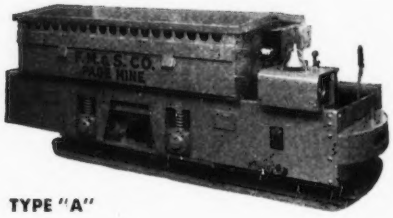
HAVE THAT EXTRA QUALITY
FOR DAY AFTER DAY OPERATION



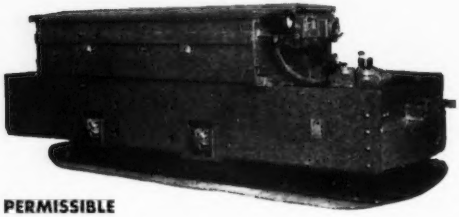
TYPE "J"
1½-TON TRAMMER

A quality locomotive engineered to modern mining needs. Adequately powered to haul capacity loads. Rugged enough to stand up under continuous operation. Atlas Locomotives are available in standard sizes or built to your specific requirements.

The Atlas Type "A" is a low cost, trouble free locomotive for main line service. Rugged, heavy-duty construction enables you to maintain top production schedules. Type "A" is equipped with Atlas Double-Reduction Spur Gear Drive. Furnished in 3 and 4 ton sizes.



TYPE "A"



PERMISSIBLE

Approved by the Bureau of Mines for gassy locations, this locomotive has proven time and again its dependability and ability to outperform all others at a minimum of maintenance costs. These locomotives provide the ultimate in safety and accessibility.

Here is a storage battery locomotive specifically designed for intermediate haulage. The patented Atlas Double-Reduction Spur Gear Drive offers dependable, positive operation under heaviest load requirements. Special attachments, equipment or designs to meet particular mine conditions can be furnished.

TYPE "K"

COMPLETE DETAILS AND SPECIFICATIONS ON ALL THESE TYPES ON REQUEST.

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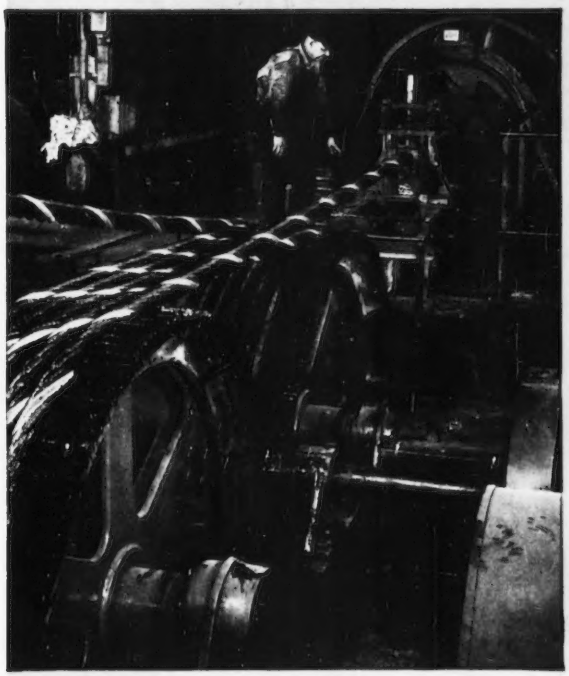
THE ATLAS CAR & MFG. CO.

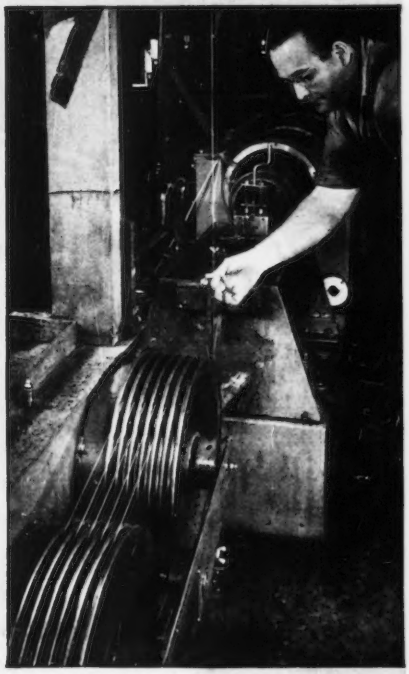
ENGINEERS MANUFACTURERS

1140 IVANHOE RD. CLEVELAND 10, OHIO, U. S. A.

This photograph shows a 3⅛" diameter Monarch Whyte Strand Wire Rope coming off a Macwhyte closing machine. Weight of this rope is approximately 16.65 pounds per foot. It has a strength of approximately 392 tons and is used for the digging line on large dragline excavator with 35 cu. yd. bucket.



In this photograph is a 3/64" diameter Stainless Steel Cord coming off a Macwhyte closing machine. It weighs approximately 0.35 lbs. per 100 feet; has a strength of approximately 270 pounds, and is used for many small cord needs.



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LARGE WIRE ROPE or SMALL WIRE CORD

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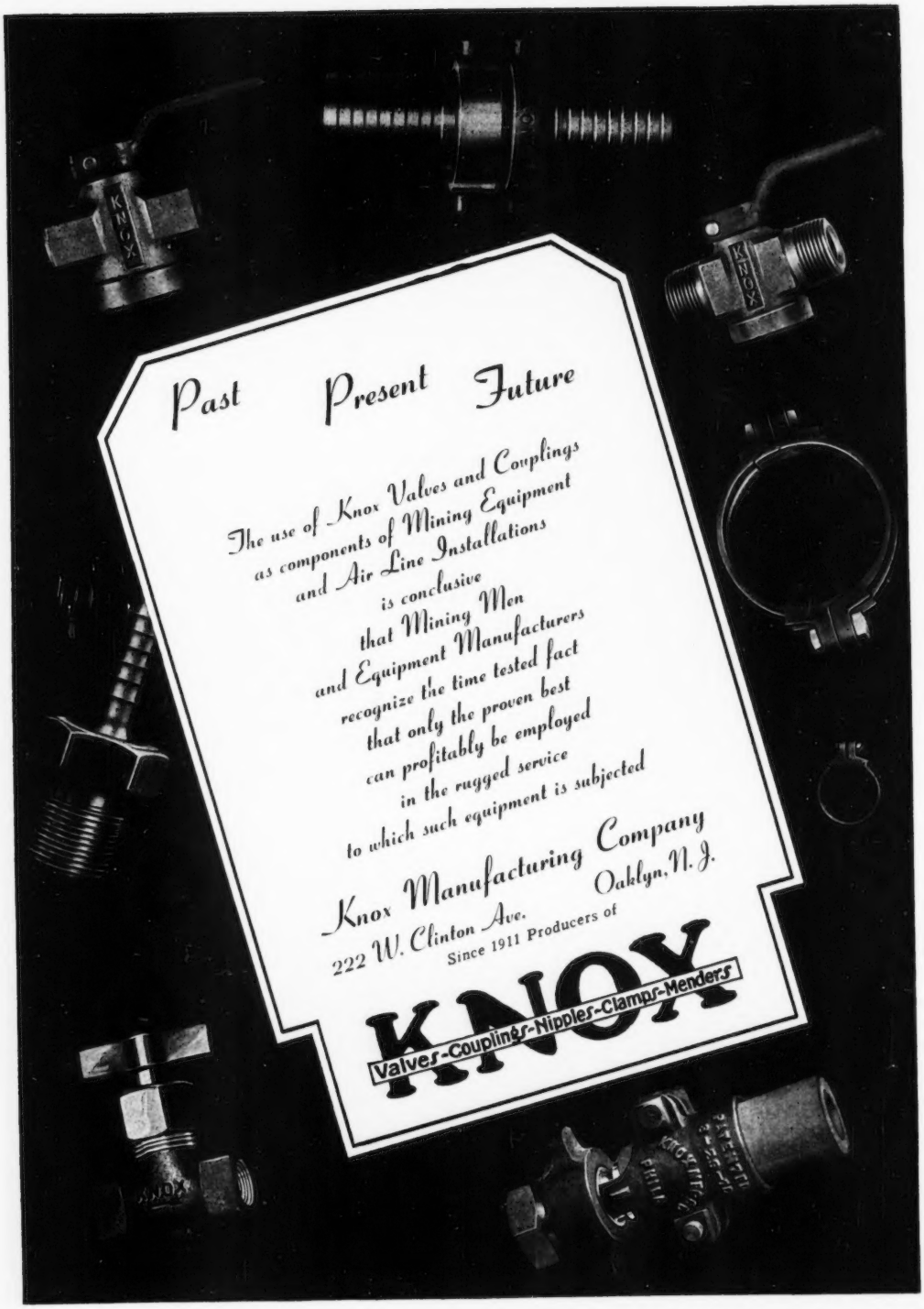
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recognize the time tested fact
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can profitably be employed
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Controlled hardenability, excellence of stress-bearing surfaces and uniform processing all contribute to the assurance of *lower cost per foot drilled* when you use Crucible Hollow Drill Steel.

And to back up this fact, *every lot* of Crucible Hollow Drill Steel is given an accelerated fatigue test which is correlated with *actual granite drilling*. That means rugged dependability is built right into Crucible Hollow Drill Steel.

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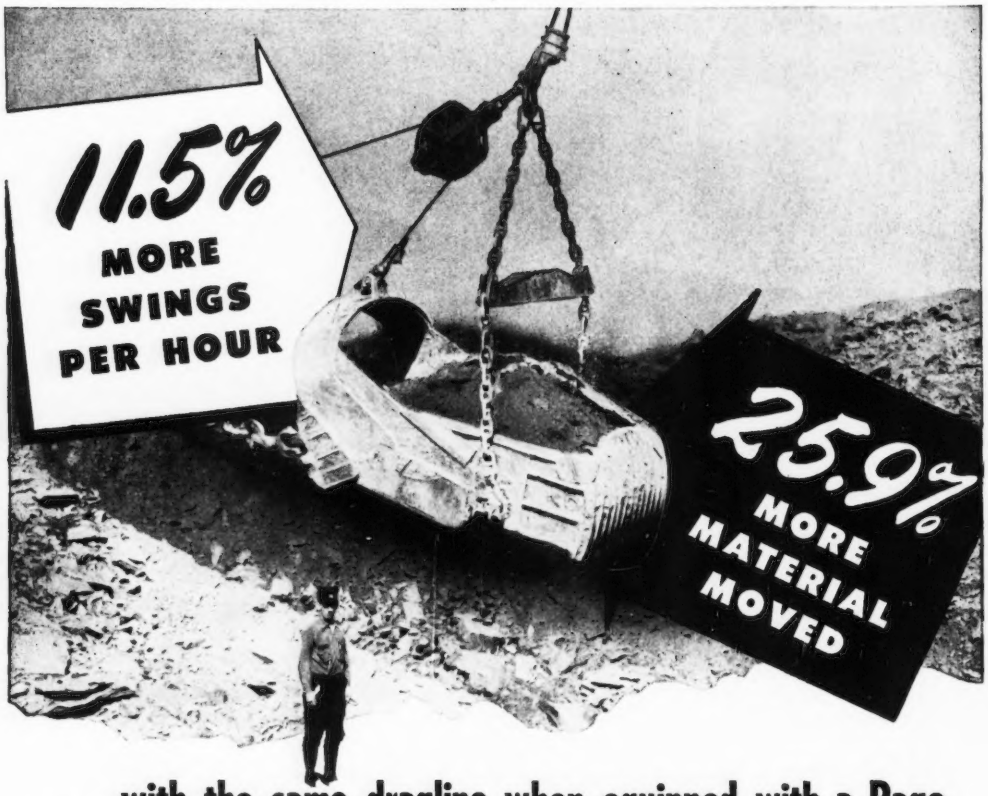
HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE • **STEELS**



. . . with the same dragline when equipped with a Page AUTOMATIC

Rated capacity cu. yds.	No. of 24-hour days in use	No. of bucket loads in period worked	User's Engr's estimate of cu. yds. per bucket load	Total cu. yds. excavated in period worked	Cu. yds. excavated in 24-hour day	Average number of bucket loads per hour
25 Cu. Yd. Competing Bucket	15 consecutive days	19,685*	20.2	397,637	26,509	54.68
25 Cu. Yd. Page Automatic	16 consecutive days	23,424*	22.8	534,067	33,373	61.0

*Recorded by Esterline-Angus

On an actual 16 consecutive day run with all conditions alike — the same dragline, the same operators and the same material, a 25 cu. yd. Page AUTOMATIC Dragline Bucket outperformed a competitive bucket of the same rated size by a wide margin. The table gives all the facts found by a well-known coal company which made the test to determine the best bucket for their own stripping operations.

Assuming that both buckets carried equal loads, the Page AUTOMATIC made 11.5% more swings per hour. Considering both the increased number of swings and larger loads, the Page AUTOMATIC moved 25.9% more material than the competing bucket.

The extra bucket loads were obtained by the AUTOMATIC because of its quick loading features. Generally, little more than two lengths of the bucket are required to pick up a full load.

The increased yardage moved with the AUTOMATIC was due to its ability to obtain full loads on every trip while the competing bucket did not load the back end once out of ten times.

No effort was made during the test to determine the amount of dragline pull necessary to operate either bucket. However, other installations have proved that a Page AUTOMATIC requires up to 25% less dragline pull than the usual old style bucket.

Whether you need a small bucket or a big one, you can always move more yardage at less cost with a Page AUTOMATIC.

PAGE ENGINEERING COMPANY, Clearing Post Office, Chicago, Illinois

Over 100 Times Longer Service in...

- **Conglomerate**
- **Granite**
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In Eastern Pennsylvania conglomerate, Kennametal 2 inch Rock Bits used on drifters drill 110 times longer, 23% faster than steel bits, and lower bit cost 37% per foot.

In Southern Virginia granite, Kennametal 2¼" Rock Bits last 150 times longer, drill 350 feet per bit, and increase the footage drilled per drifter over 50% per shift.

For drifter service in upper Michigan iron ore, Kennametal 1¾" Rock Bits drill 185 times longer and average nearly 300 ft. per bit.

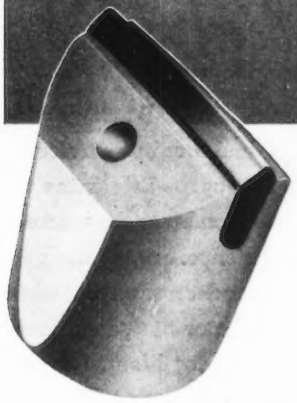
On a wagon drilling job in Central Pennsylvania, Kennametal 2¼" Rock Bits drilled 250 times as long as steel bits and saved $100,000 on drilling costs.

For drilling sandstone in Northern West Virginia, Kennametal 2¼" Rock Bits gave 330 times longer service, drilled 33% faster.

Kennametal 2¼" Rock Bits used on wagon drills in Western Pennsylvania drill 150 times farther and give 900 feet of drilling per bit.

with Kennametal Rock Bits

SUPER TOUGH



—and they give you these money-saving, profit-making advantages:

- Less strain on machines, big reduction in maintenance cost
- Better blasting, less money for explosives
- More footage drilled per shift
- Greatly reduced bit cost per foot
- 25% to 50% faster drilling
- Less bit changing and bit handling

Send for complete particulars

Mining Division
Kennametal Inc., Latrobe, Pa.

KENNAMETAL

Trade Mark Reg. U. S. Pat. Off.

Rotary Drill Bits • Core and Drag Bits • Rock Bits

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KENNAMETAL Inc., Latrobe, Pa.

Please send me a free copy of Booklet on drilling

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Also send information on:
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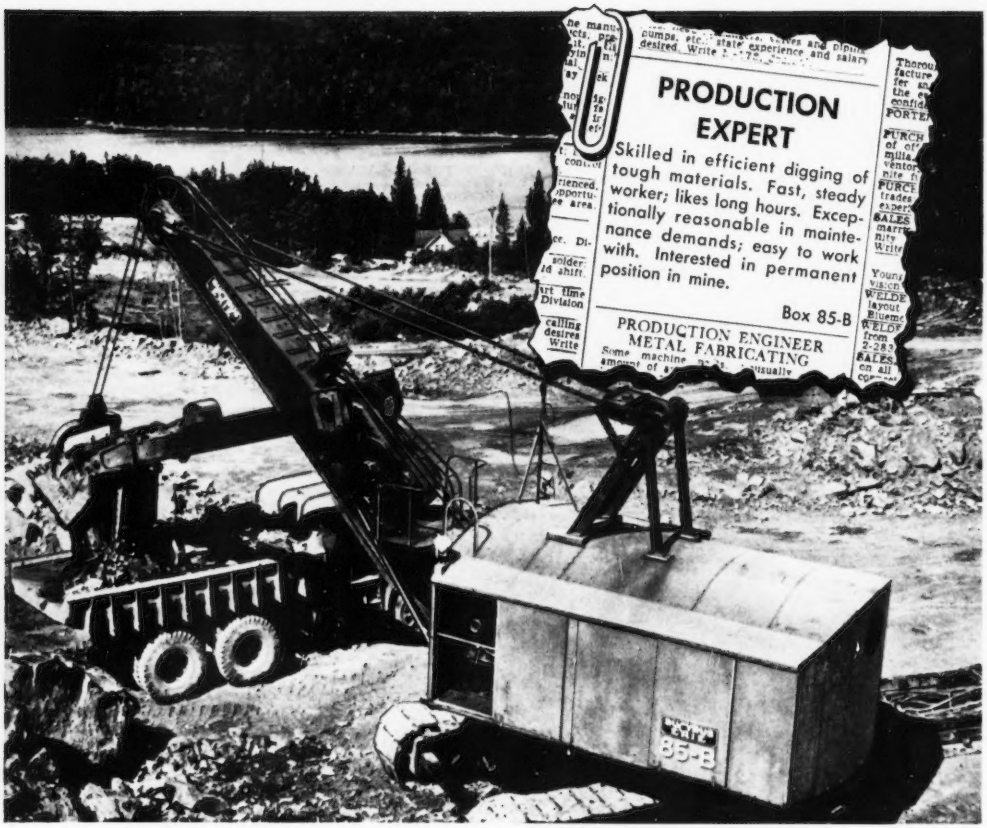
PRODUCTION EXPERT
Skilled in efficient digging of tough materials. Fast, steady worker; likes long hours. Exceptionally reasonable in maintenance demands; easy to work with. Interested in permanent position in mine.
Box 85-B
PRODUCTION ENGINEER
METAL FABRICATING
85-B

Worth Investigating!

From the standpoint of high output, economical operation and utility, the Bucyrus-Erie 85-B is an excavator worth investigating, for this capable 3¼-yd. machine offers all three. Balanced speeds, torques and weight placement combine with ample power under perfect control for a fast cycle that boosts production. Smooth operation with simple Ward-Leonard control reduces operating stresses, while elimination of all operating clutches and brakes with their maintenance and adjustment time means lower upkeep costs. The 85-B also provides outstanding crane and dragline service and — like the other Bucyrus-Erie mine and quarry machines — combines the resources of wide field experience, engineering skill and unequalled modern manufacturing facilities in an excavator of "years ahead" design, durably built for lifetime service.

67L49

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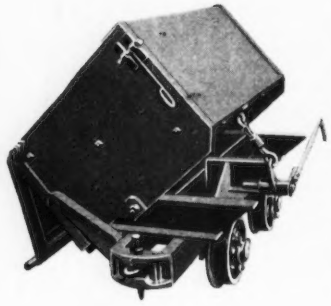
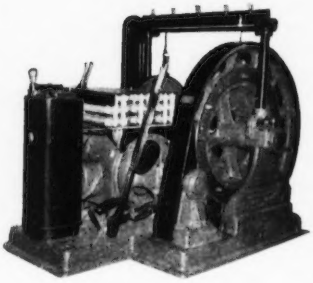
FAST, DEPENDABLE HANDLING FROM LOADER TO STORAGE BINS WITH COEUR D'ALENE CARS, SKIPS AND HOISTS



LEFT: "AJAX" (Patented) side dump car, in dumping position 21 to 50 cu. ft., hand operated. One man can easily handle the larger sizes.

RIGHT: "JUNIOR," or "Package" type HOIST. 15 to 40 H.P. For small properties, Winzes or shaft sinking.



OTHER CARS:

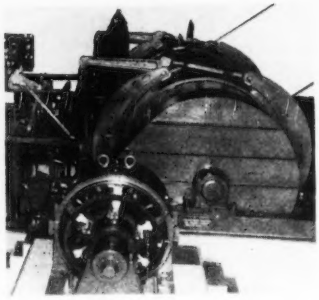
"HY-LINE" Side Dump Car and Dump (Pat. Pend.) 60 to 120 cu. ft., power dump, with manual control.

ROCKER DUMP type, 25 to 60 cu. ft.

END and SIDE DUMP type, 16 to 27 cu. ft.

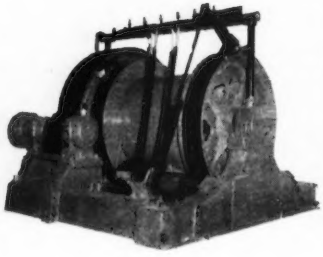
HOPPER BOTTOM type, 43 to 115 cu. ft.

Ask for bulletin #75



COEUR D'ALENE ELECTRIC HOISTS, single and double drum, 15 to 1000 H.P., Drums to 10 ft. diam.

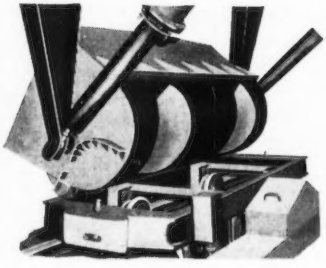
OUTSTANDING FEATURES: Roller bearings throughout. Close drum spacing—permits shorter rope raises. Dependable, durable multiple-disc clutches, having very low WR^2



ABOVE: 500 H.P. DOUBLE DRUM ELECTRIC HOIST, WITH WARD-LEONARD CONTROL.

LEFT: SINGLE DRUM ELECTRIC HOIST, 100 to 150 H.P., in type shown.

RIGHT: "NEYMATIC" (Pat. Pend.) SIDE DUMP CAR in partially dumped position. 80 to 160 cu. ft., hydraulic dump, automatic control.



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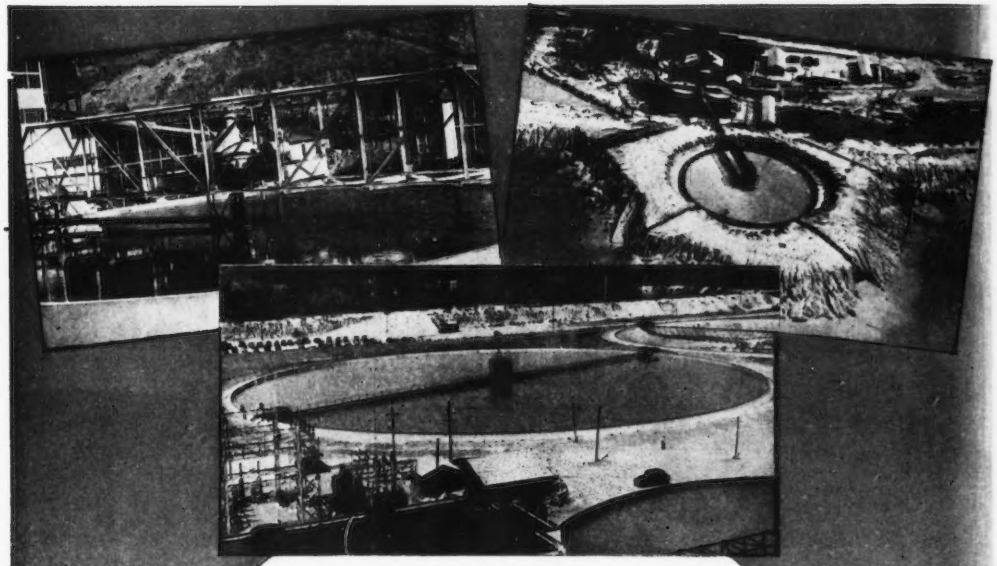
Builders of Quality Mining Machinery Since 1884



UP-TO-DATE THICKENERS SAVE YOU MONEY EVERY DAY THEY OPERATE

The completely automatic, practically fool-proof operation of General American thickeners and hydroseparators has set new performance standards.

They prevent shutdowns from overload feeds, underflow pump or power failures.

They will take full feed without prescreening or preclassification.

They may be utilized for storage while operating or started by push button control after a prolonged shutdown.

Check your present operations and let a General American engineer assist you in designing new units or modernizing your existing ones.

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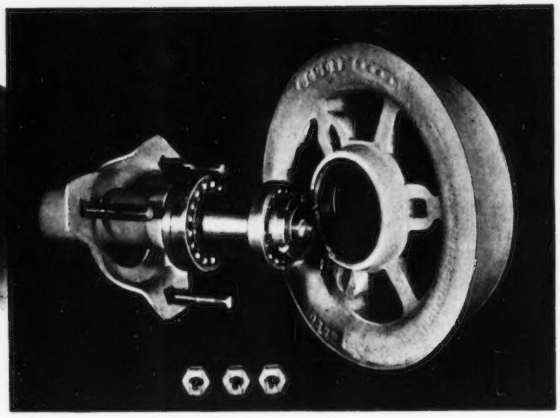
are "FLOATERS" Demountable?

YES!..and in less time than it takes to smoke a cigarette...



Here's the mine car wheel that you demount as easy as changing the wheel on your automobile. Remove three nuts, slip the S-D "Floater" wheel off, and the bearings remain in perfect adjustment on the axle. When a wheel needs replacing, you want it done *now* — in a hurry. Changing a "Floater" is so quick and simple that it doesn't even require an experienced mechanic. Because of precision fit and closed hub, grease leakage is eliminated to a point where the "Floater" requires fewer greasings than any mine car wheel made. The "Floater" principle of one set of bearings locked and one set which "floats" automatically into perfect adjustment, reduces bearing replacements to a minimum because pinching, out-of-alignment, loose or tight bearings are impossible. When it comes to performance, there is no equal to "Floaters." Independent engineers' tests have proved that up to 50 per cent greater tonnage may be hauled with no increase in power consumed in cars having "Floater" wheels as compared to other types of precision bearings. Write today for Wheel Folder No. 7105.

20 Car loads of "Automatics" from—

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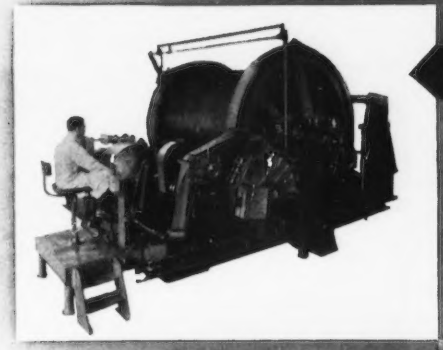

SLOPE HOISTS

Illustrated is a two speed Slope Hoist for load of 35,000 Lbs. on a 5300 foot incline with a maximum grade of 39° 10'. Rope 1¾" diameter. Drum 92" diameter x 102" face, welded steel. Herringbone Gears. Low speed 200 F.P.M. High speed 400 F.P.M.

SHAFT HOISTS

This Shaft Hoist furnished to handle a "pay load" of 25,000 Lbs. in a 1100 ft. deep shaft at 750 F.P.M. Maximum cross load on drum shaft 68,800 Lbs. Drum, welded steel, 96" diameter x 124" face. Rope 2⅛" diameter. Herringbone Gears. 108" Post Brake.

We also build Drill and Exploratory Hoists

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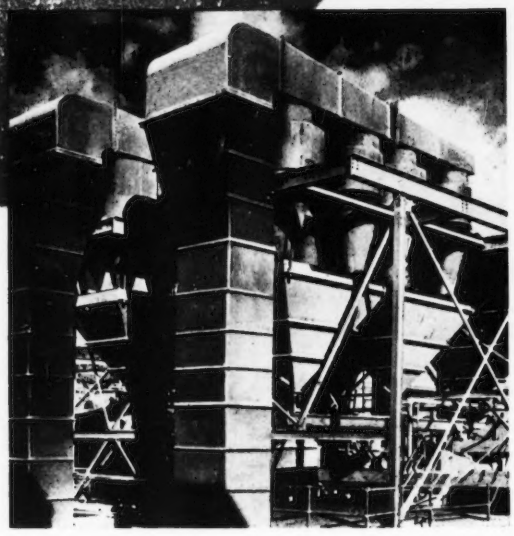

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BLAST FURNACES

ROASTERS

REVERBERATORY FURNACES

SINTERING MACHINES

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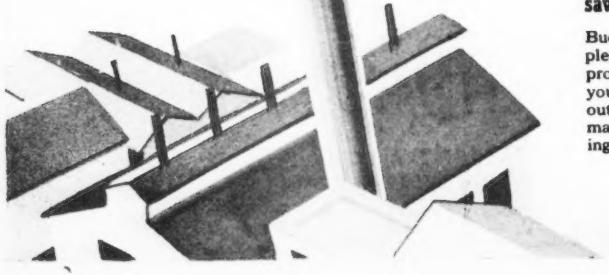
SMELTERING FURNACES

Not forgetting the Fly Ash from your solid fuel firing



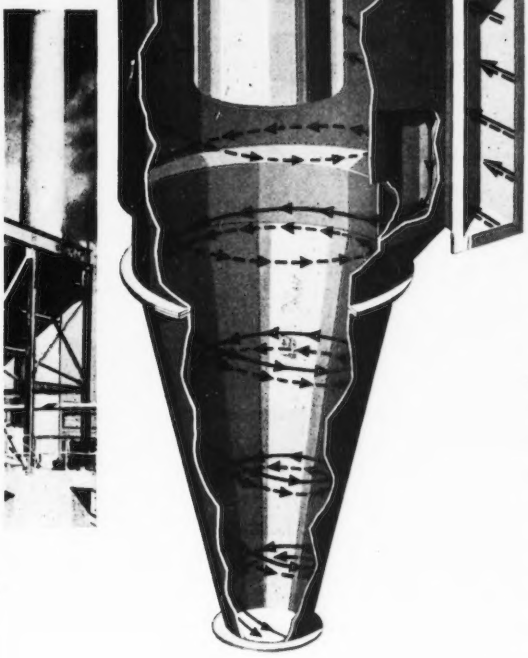
RID YOURSELF OF NUISANCE DUST from crushing, milling or dry handling operations... protect health... save machines, motors and bearings from abrasive grit

Buell System dust collection offers *cost advantage* coupled with complete *operating satisfaction.* Whatever your problem in improving health conditions, you owe it to yourself to investigate what Buell has to offer. If you will outline your problem in general terms, we shall try and make our reply more specific than that of merely sending a catalog.

values with buell

VAN TONGEREN PATENT

DUST COLLECTION



Mining Men from Alaska to the Andes and to far Australia are increasingly alert to the *dollars to be saved* with Buell System dust collection. Thousands of dollars in values which escape as gas-borne particles can be recaptured with simple, relatively inexpensive equipment.

● Buell comes in for first consideration in the recovery of values from dry dusts of average particle size. Collection performance curves indicate efficiencies which are bound to pay out handsomely. There are no temperatures which limit use in ordinary metallurgical practice.

● Here is mechanical dust collection with no moving parts, negligible operating expense, and next to no maintenance. No housing expense, the Buell System can be installed anywhere.

● No ordinary cyclone, this! Buell's incorporation of the patented van Tongeren "Shave Off" gives this cyclone unique and different aerodynamic characteristics.

The resultant efficiencies warrant your most searching investigation . . . particularly when the cost of equipment offers such great savings.

Write us for catalog information for general reference—or informative data along some line in which you are especially interested.

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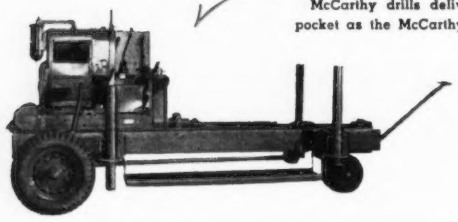
McCarthy Drills PAY OFF!

SELF-PROPELLED HORIZONTAL DRILL



McCarthy drills deliver 40% more holes per day! More money goes into your pocket as the McCarthy drills save time and labor on the job.

Operating effectively in clay, sandrock and soft limestone overburdens, McCarthy Horizontal Drills bore 1200 to 1800 feet per day, working easily to depths of 150 feet or more.

Maneuverable from one job to the next, the machine is adjustable to the necessary drilling angle and is available in self-propelled, truck-mounted or vertical models. Every McCarthy Drill pays its own way in record-breaking performance.

DOUBLE YOUR PRODUCTION

HEAVY – RUGGED – POWERFUL

VERTICAL DRILL

The McCarthy Vertical Drill makes "dry" holes ready for tamping and it makes them fast. This drill bores 400 to 1000 feet per day.

Through shale, sandrock or soft limestone formations, McCarthy drills quickly penetrate to depths of 100 feet or more. Adaptable to high wall, key drilling and diamond drill boring. Write for the full story today.

Hydraulically controlled derrick and 60 horsepower gasoline motor are standard equipment. All McCarthy Drills can be equipped with electric motors.

INCREASE YOUR PROFITS

HEAVY – RUGGED – POWERFUL

COAL RECOVERY DRILL

McCarthy Coal Drills by-pass overburden, drill right into the heart of the seam. These drills produce from 60 to 110 tons of coal per day. In one mine where thick overburden made further stripping impractical, three men took a McCarthy Bonus Drill and pulled out 7 tons of clean, dirt-free coal in only 35 minutes!

The rugged augers are made in 8 foot interlocking sections, are available in 12, 16, 20, 24, 30 and 36 inch diameters.

SALEM

MANUFACTURED BY

THE SALEM TOOL CO.

S. ELLSWORTH AVENUE
SALEM, OHIO, U. S. A.

LOW COST PER UNIT OF WORK

Suppose you're considering two competitive brands of wire rope. They look alike, but one sells for a little less than the other. Bargain? Often it's anything but a bargain. For purchase price alone isn't the measure of wire-rope economy.

Sometimes you may find a wire rope with a lower price tag than Bethlehem's. But how does the cheaper one compare in total service rendered? How about its *Cost per Unit of Work?*

What a unit of work is depends, of course, upon the industry involved. It can be a ton of rock moved by a power shovel. Or a car of coal hauled up a slope. Or a ton-mile in oil-country rotary drilling. But in any case, unless your final rope Cost per Unit of Work is *low*, the rope has not done an economical job for you. That's why first cost—purchase price—isn't the sole yardstick.

Bethlehem wire rope is a quality product, one conscientiously built for long-range economy. When you buy it, you are spending your money wisely. You are buying wire rope that means, in the truest sense, *low* Cost per Unit of Work.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

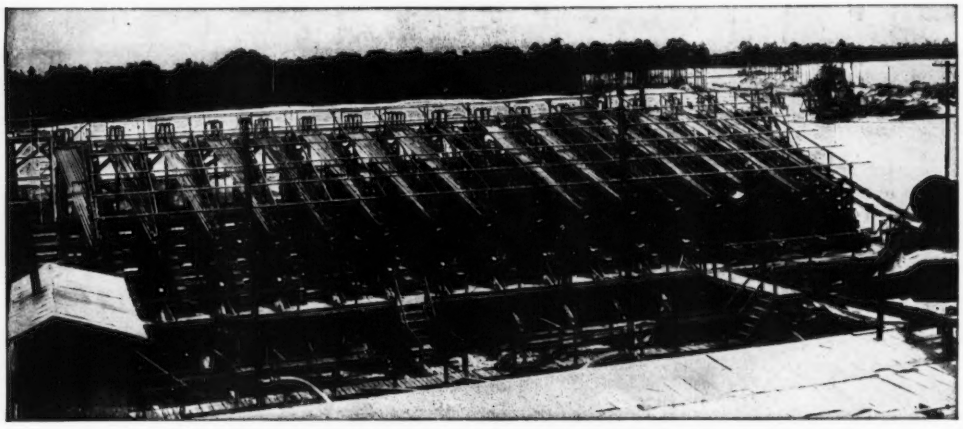
Export Distributor: Bethlehem Steel Export Corporation

HUMPHREYS SPIRAL CONCENTRATOR

Low cost of installation. No moving parts. Low operating costs.

THE HUMPHREYS INVESTMENT COMPANY—ENGINEERING DIVISION

914 FIRST NATIONAL BANK BLDG. • DENVER 2, COLORADO



192 of a unit of 252 first stage spirals handling 380 tons of sand per hour delivered to the unit by one 10" sand pump. Floor space of the unit 132' x 40'. No concrete foundations used. Average cost of spiral operation during 2½ year period, 2½c per ton of feed. Pumping cost, including disposal of spiral tailing amounting to over 90% of feed, 2½c per ton of feed.

for **separation of minerals of different specific gravity in ores at sizes generally minus 10 mesh.**

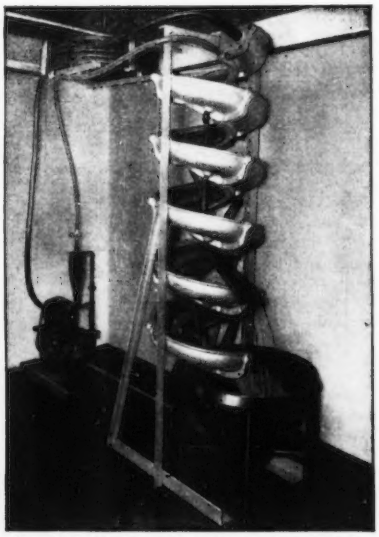
for **concentration of old mill tailing prior to recovery of values by regrind and flotation of spiral concentrate.**

for **recovery of high iron, low silica concentrate from iron ore washer tailing.**

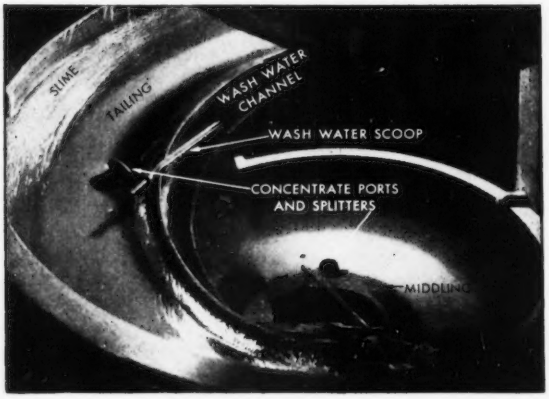
for **cleaning minus ¼ inch bituminous or anthracite coal.**

for **separation of fine phosphate rock from sand.**

Write for descriptive bulletins.



Closed circuit test unit including single spiral of full size. Results obtainable in a full size plant may be determined by tests of representative sample of approximately 200 lbs.



Concentrating action of spiral. Note wide black band of concentrate entering upper outlet, which is set for a wide cut, also narrow black band of middling entering lower outlet set for thin cut. In cleaning fine coal, refuse and middling are discharged from the concentrate ports and cleaned coal follows the path shown as tailing above.

Sprague & Henwood

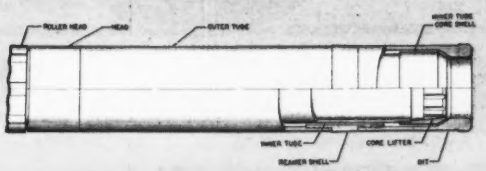
CORE DRILLING MACHINES Prove Their Worth In The Toughest Field Assignments . . . Combining Excellent Service With Economical Operation

That statement of fact is the reason why you should investigate these machines before buying Diamond Drills. • Design features, which are the result of years of practical field experience, include high grade castings, alloy steels, machine cut gears, etc., resulting in a machine of sufficient strength and stability to give excellent and uninterrupted service over long periods of continuous operation. • Four distinct swivel heads are available, as are four types of power units—Gasoline engine, Diesel engine, Air engine, or Electric motor. • You are assured low cost operation, less time loss due to breakdowns, few replacements and *proved* low-drilling costs. • We invite you to write for full information today.

CORE DRILLING BY CONTRACT

Sprague & Henwood, Inc., is also prepared to undertake Core Drilling by contract. This includes test boring or mineral prospecting and also foundation exploration for dams, bridges, buildings, etc. Drilling grout holes and grouting also performed on contract basis. Thoroughly experienced supervisors and operators available for contract drilling operations. Send us your inquiries for Core Drilling by contract.

NEW: A DOUBLE TUBE CORE BARREL—*For Better Core Recovery.* **The Series "M" Double Tube Core Barrel differs from others in that the inner tube is equipped with a shoe or case extending to the face of the bit and housing the core lifter. This reduces the tendency to block.**



"TRUCAST" BORTZ DIAMOND BITS—*Have Proved Their Worth:*

A mechanically set Bortz Diamond Bit which provides uniformity of contour and gauge. Can be furnished in all standard sizes and many special sizes as well. "TRUCAST" bits have been used in all types of diamond drilling for years and have well proved their worth.

Sprague & Henwood, Inc. SECTION 2, PA

TOE LUGS THAT NEVER WEAR OFF!

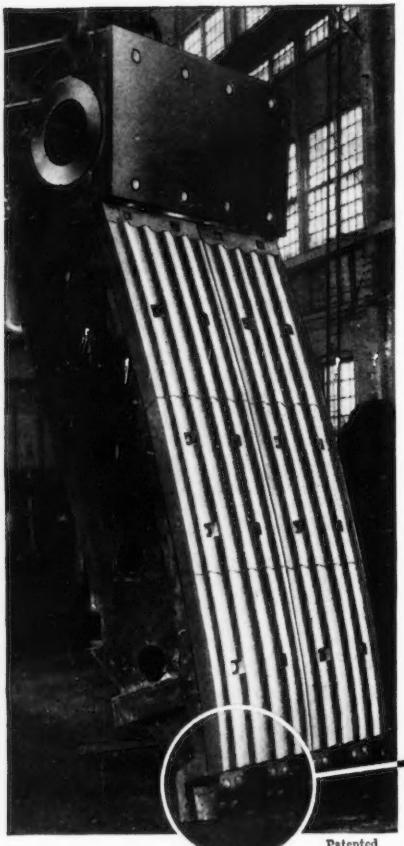
ON BIRDSBORO-BUCHANAN JAW CRUSHERS

• Introduced several years ago by Birdsboro engineers, this patented Offset Toe Lug was a radical departure in crusher jaw design. Today, it is still the outstanding development—and available only on Birdsboro-Buchanan Jaw Crushers.

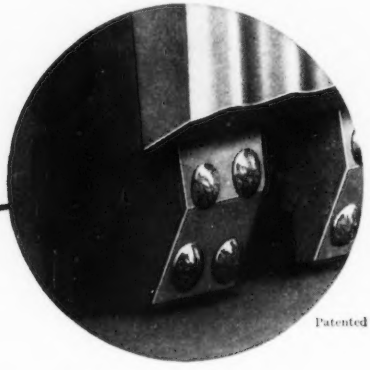
The photograph shows how the toe lugs have been moved back—away from the face of the jaw plate. This means that plates can wear down to a mere shell—and the *toe lugs can't possibly wear off.*

The toe lugs used on conventionally-designed crusher plates extend outward to the corrugations. As these plates wear, the lugs become battered and useless, for their prime purpose is keeping plates in position. This means that plates must be replaced when they are but 50% worn.

Birdsboro Offset Toe Lugs allow considerably more wear on plates. Many operators using them, on both swing and stationary jaws, report as much and more than 100% increase in useful jaw plate life and a 50% reduction in maintenance costs. Write to us for complete information on this and other outstanding features of Birdsboro-Buchanan Jaw Crushers.



Patented



Patented

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PA.

DESIGNERS AND BUILDERS OF:
Crushing Machinery • Rolls • Steel Mill Machinery
Hydraulic Presses • Special Machinery • Steel Castings

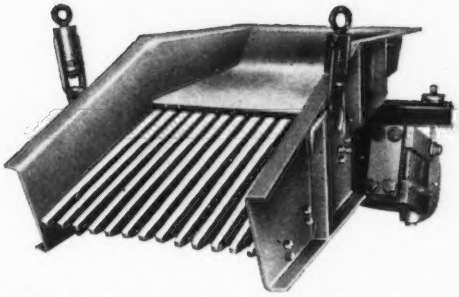
World Wide Agent Representation. Contact home office for nearest representative.

Canadian Representative & Manufacturer
JOHN INGLIS CO. LTD., TORONTO, CANADA

BIRDSBORO
BUCHANAN JAW CRUSHERS

SYNTRON

Speeds Up Bulk Material Handling



VIBRATING GRIZZLIES

Features

Increase crushing capacity and efficiency.

Bypass fines—oversize to crusher.

Feed and scalp in ONE operation.

Smooth, controlled flow assures even belt loads.

Cushion the heavy abrasive lumps on a bed of fines and prevent rollback of lumps on steeply inclined belts.

Variable Control of Rate of Flow

A turn of the rheostat or reactor dial increases or decreases volume flow. The control can be manual or automatic.

No Motors, Speed Reducers, Gears, Belts, Etc., to Be Maintained

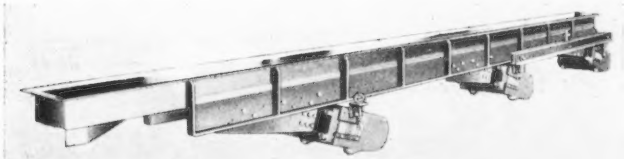
Syntron Vibrating Grizzlies are powered by simple, pulsating electromagnets and require a minimum of power. Movement is confined to the flexing of leaf springs by the electromagnet.

If You Have a Scalping or Separation Problem

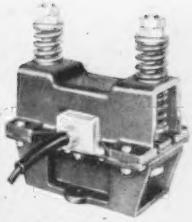
Our Engineering Department will be pleased to submit recommendations and prices—if you will write us, giving such details about your problem as—required tonnage per hour, character of material, purpose of separation, percentage of through material, size of grizzly openings, etc.

SYNTRON CO.

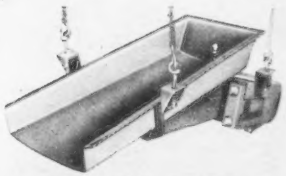
510 Lexington **Homer City, Pa.**



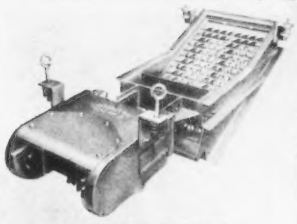
LONG "Vibratory" CONVEYORS
No Motors, Gears or Other Mechanical Wearing Parts



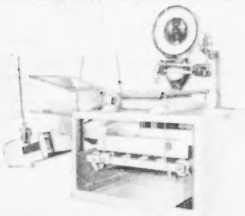
BIN VIBRATORS
Make Stubborn Materials Flow Freely



VIBRATORY FEEDERS
Up to Hundreds of Tons per Hour — Rheostat Control of Flow

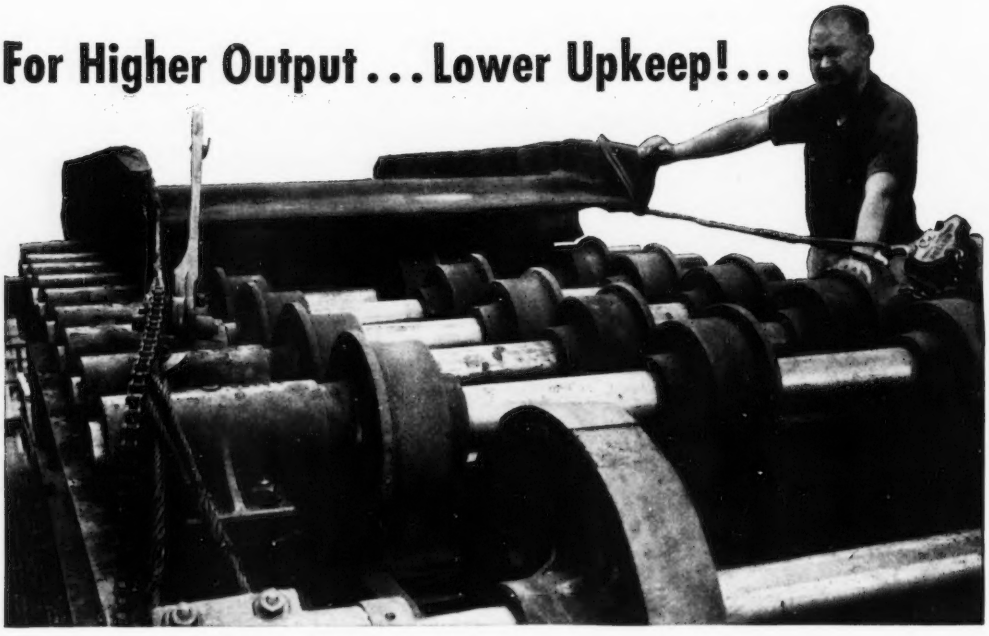


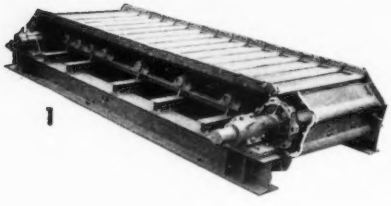
VIBRATING SCREENS
Wet or Dry — Single or Multiple Decks



"CONSTANT WEIGH" FEEDERS
Accurate, Continuous Feed by Weight

For Higher Output . . . Lower Upkeep! . . .





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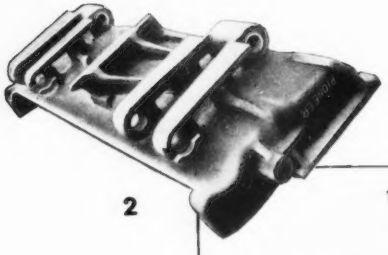


2

When feeding heavy abrasive materials

Iron ore, flintrock, granite, the toughest materials, demand strong, heavy-duty equipment. "Down time" on just one piece of machinery can stop production throughout the entire plant.

For that reason one of the leading mining companies on the Minnesota iron range bought its third PIONEER-ORO Manganese Steel Apron Feeder. Assisting in the installation of this 60" x 16' 3" feeder on the Cuyuna range is C. T. Hendrickson, Pioneer Mines Engineer.

All wearing parts of this heavy-duty feeder are Oro Supermang steel, a superior grade of manganese steel. Head sprockets are equipped with replaceable Supermang teeth; tail sprockets, with Supermang pads to reduce link wear and keep maintenance to a minimum.

If you're handling tough, abrasive material, write for information about PIONEER-ORO Manganese Steel Apron Feeders. Our new folder will give you complete details.

PIONEER ENGINEERING WORKS

1515 Central Avenue — Minneapolis 13, Minnesota

1. PIONEER-ORO FEEDERS are now available in four widths: 36", 42", 48" with nine inch pitch; the 60" feeder has 15 inch pitch.

2. To save maintenance. Links are cast as part of the pan. Non-turning alloy steel connecting pins fit in Supermang non-turning, replaceable bushings in the link eyes.

BUY BOTH!

Higher Output, Lower Upkeep!

Pioneer

Continuflo **EQUIPMENT**

For BIGGER and BETTER yardage in tough digging

SWITCH TO THE MARION LINE FOR '49

Do your '49 jobs call for high yardage in tough digging? Put a MARION on the job this year and get a new conception of dependable service in heavy duty digging.

HERE IT IS!

GASOLINE
DIESEL
ELECTRIC

MODEL	CAPACITY	MODEL	CAPACITY	MODEL	CAPACITY
33-M	¾ cu. yd.	492	3 cu. yds.	5323	18 cu. yds.
362	1½ cu. yds.	*111-M	3½-4 cu. yds.	5561	40 cu. yds.
372	1¾ cu. yds.	4161	5 cu. yds.	**7200 Walker	5-7 cu. yds.
*93-M	2½-3 cu. yds.	151-M	6 cu. yds.	**7400 Walker	8-12 cu. yds.
				**7800 Walker	30 cu. yds.

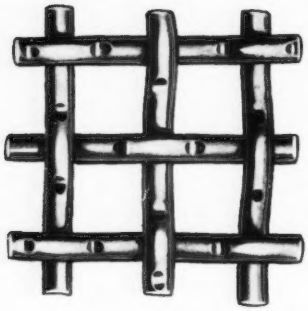
*Diesel Clutch type and Ward-Leonard electric. **Size of bucket depends on length of boom.

WHAT IS YOUR MATERIAL HANDLING PROBLEM?

MARION
POWER SHOVEL COMPANY
MARION, OHIO, U. S. A.
Offices and Warehouses in all Principal Cities

Cut Milling Costs with CF&I WIRE CLOTH and GRINDING BALLS

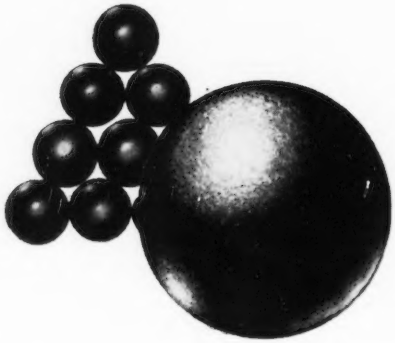
CALWICO CF&I WISSCO WIRE CLOTH



Calwico-Wissco wire cloth is available in sizes from fine filter cloth to 5-inch space cloth . . . made in bright or galvanized steel, brass, copper, bronze, monel, aluminum, stainless steel, and other metals . . . for use on filters and vibrating, revolving, and stationary screens.

Thus, you can get the best wire cloth for each particular application in your milling operation . . . the wire cloth which will help you cut your milling costs.

CF&I FORGED STEEL GRINDING BALLS



CF&I FORGED STEEL GRINDING BALLS are hot-forged of tough, abrasion-resisting steel and carefully heat treated for uniform wearing qualities. There are no soft spots; thus they stay round, providing maximum grinding efficiency through their long life . . . and cut your grinding costs.

OTHER CF&I PRODUCTS FOR THE MINING INDUSTRY: Wickwire Rope, Grinding Rods, Realock Fence, Clinton Welded Wire Fabric, Grader Blades and other Cutting Edges, Mine Rails and Accessories.

The Colorado Fuel and Iron Corporation

GENERAL OFFICES: DENVER, COLORADO

IN THE EAST: THE WICKWIRE SPENCER STEEL DIVISION, NEW YORK CITY, NEW YORK

IN THE WEST: THE CALIFORNIA WIRE CLOTH CORPORATION, OAKLAND, CALIFORNIA

WICKWIRE ROPE

A PRODUCT OF CF&I

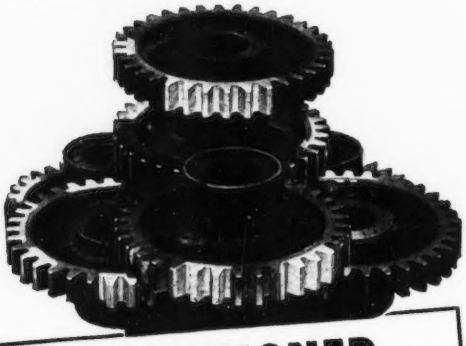
Ask any user . . . you'll find them everywhere

In scores of industries, users of Wickwire Rope have developed an affectionate respect for its performance, safety and long life. And, for true economy, they use Wickwire's WISSCOLAY® Preformed. It lasts longer — is easier to cut, splice and install. It's kink-resistant and safer to handle. Wickwire Distributors and Rope Engineers, in key cities everywhere, are prepared to render prompt service in meeting your wire rope needs. Wickwire Rope Sales Office and Plant — Palmer, Massachusetts.

IN THE EAST — Wickwire Spencer Steel Div. of C. F. & I., 500 Fifth Ave., New York 18, N.Y. • IN THE ROCKIES — The Colorado Fuel and Iron Corp., Continental Oil Bldg., Denver 2, Colo.
ON THE WEST COAST — The California Wire Cloth Corp., 1080 — 19th Ave., Oakland 6, Cal.

REPAIRED

Punch Press frame repair-welded with 52 lb. of 3/8" Tobin Bronze by the Sutton-Garten Company, Indianapolis, Ind. Job took one day for preparation and one day for welding.



RECONDITIONED

This group of worn and broken gears from wire braiding machines was quickly and economically reconditioned with Tobin Bronze Welding Rod.

...by TOBIN BRONZE WELDING

Almost any piece of equipment made of cast iron, malleable iron, steel or copper alloys can be quickly and economically repaired by oxy-acetylene welding with Tobin* Bronze.

Because of the low temperature used when welding with bronze, no serious stresses are set up, there is less chance of warping or cracking and parts can often be welded without dismantling equipment.

For years, this method of bronze welding has been used for reclaiming broken, fractured or worn equipment, or for building up bearing surfaces—at a fraction of the cost of replacement parts.

Write for Publication B-13, containing detailed information on Anaconda Welding Rods, including Tobin Bronze and "997" (Low Fuming). 47171A-Rev.

*Reg. U. S. Pat. Off.

ANACONDA
Trade Mark Registered

Anaconda

WELDING RODS

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

We changed from steam to an **Industrial Brownhoist Diesel Crane**

It paid for itself in four years!

Here are the figures to prove it:

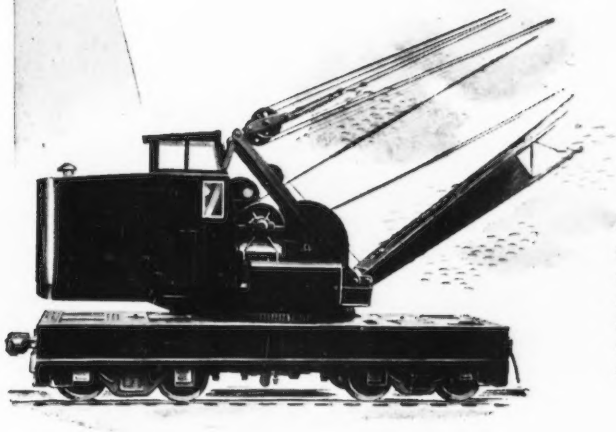
SAVINGS IN FUEL PER DAY $13.40
(Based on 1½ tons coal per day at $10 a ton, against 16 gallons of fuel oil at 10¢ a gallon.)

SAVINGS IN LABOR PER DAY $15.50
(Unproductive firing, banking, cleaning time —2 hours for engineer at $1.75 per hour, and 8 hours fireman, at $1.50 per hour.)

TOTAL FUEL AND LABOR SAVINGS PER YEAR.. $7,514.00

AND WE INCREASED OPERATING TIME BY 65 DAYS A YEAR!

It takes two hours a day on the average for firing up, banking, taking coal and water, boiler washouts, etc. That figures to 10 hours a week, 520 hours a year, or 65 extra days of productive crane time each year.

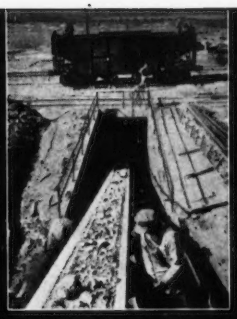
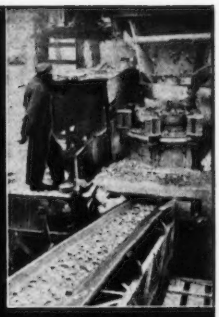


BESIDES THESE IMPORTANT EXTRAS:

Safer, cleaner operation; greater production and less operator fatigue because of air operated controls; reduced maintenance time, about one-half that of steam, and elimination of smoke nuisance and fire hazard. Write today for complete information.

BROWNHOIST BUILDS BETTER CRANES . . . with Diesel power

INDUSTRIAL BROWNHOIST CORPORATION • BAY CITY, MICH. • DISTRICT OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO • AGENCIES: DETROIT, BIRMINGHAM, HOUSTON, LOS ANGELES, PORTLAND, SAN FRANCISCO, SEATTLE, SPOKANE, CANADIAN BROWNHOIST LTD., MONTREAL, QUEBEC.

Hamilton

CONVEYOR BELTING FOR THE HANDLING OF ALL TYPES OF BULK MATERIALS

Top performance at lowest cost per ton on long and short conveying units.

Economy of operations is dependent upon continuous uninterrupted conveyor belting service.

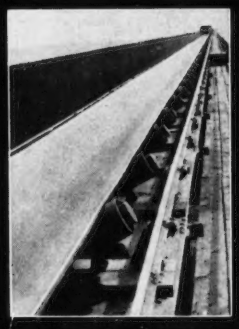
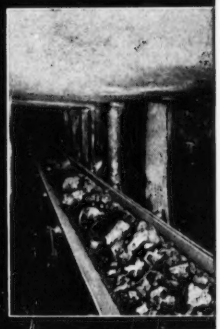
Hamilton Conveyor Belts are engineered for your particular service, and the proper conveyor belt will deliver full tonnage of abrasive, jagged, wet, hot, or materials unusual in character.

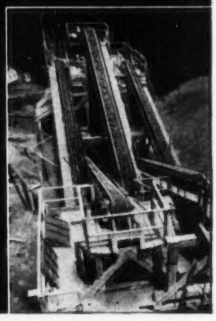
Our field representatives are ready to assist you in recommending the proper Hamilton Conveyor Belt for your requirements.

Write us for literature on our complete line of Industrial Rubber Products.

MAIN OFFICE and FACTORY—TRENTON, N. J.

New York Chicago San Francisco Los Angeles Houston Indianapolis Cleveland Pittsburgh Boston



HAMILTON RUBBER MFG. CORP., Trenton, N. J.

MANUFACTURERS OF QUALITY RUBBER PRODUCTS FOR OVER 24 YEARS

Euclid Dump Trucks **HAUL MORE AT LOWER COSTS** with body sections of J&L OTISCOLOY high-tensile steel

J&L STEEL

Above, welding a twenty-two-ton-capacity Euclid truck body made of J&L *Otiscoloy High-Tensile Steel parts.*

J&L OTISCOLOY in trucks, built for the toughest hauling jobs, pays off for both the manufacturer and truck operator.

The Euclid Road Machinery Company, of Cleveland, Ohio, has *six* good reasons for building vital parts of bodies for its heavy duty hauling equipment out of J&L Otiscoloy *High-Tensile* Steel. These bodies are built to meet today's toughest hauling requirements—*at low operating costs.* Every useless pound of dead-weight is designed *out* of the bodies in order to handle largest possible loads at high speed. Stamina is all-important, because these trucks operate in off-the-road service—in mines, quarries and heavy construction work.

The six reasons why Euclid uses J&L Otiscoloy are:

1. Otiscoloy is twice as strong as mild steel.
2. Otiscoloy has 50% greater fatigue resistance than mild steel.
3. Otiscoloy has 4 to 6 times greater resistance to atmospheric corrosion than mild steel.
4. Otiscoloy has substantially greater abrasion resistance than mild steel.
5. Otiscoloy is easily welded by any of the standard methods.
6. Otiscoloy can be readily cold formed.

If you are interested in eliminating *useless* dead-weight, obtaining better resistance to corrosion and abrasion, get *all* the facts on J&L Otiscoloy *High-Tensile* Steel. Let us send you the booklet mentioned in the coupon.

Jones & Laughlin Steel Corporation
412 Jones & Laughlin Building
Pittsburgh 19, Pa.

Please send at once a copy of your booklet: "Otiscoloy High-Tensile Steel."

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

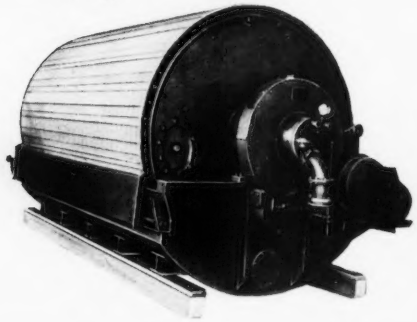
JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L *manufactures a full line of carbon steel products, as well as certain products in* Otiscoloy *and* Jalloy (*hi-tensile steels*).

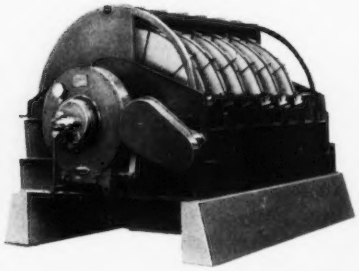
PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES • STRUCTURAL SHAPES • HOT AND COLD ROLLED STRIP AND SHEETS • TUBULAR, WIRE AND TIN MILL PRODUCTS • "PRECISIONBILT" WIRE ROPE • COAL CHEMICALS

OLIVER UNITED *offers* 7 Types of

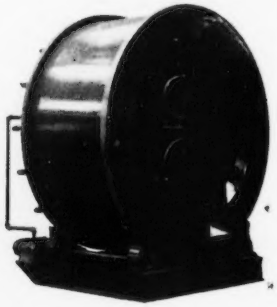
Oliver Continuous Filter
Drum Type



American Continuous
Filter, Disc Type



Dorrco Continuous Filter
Internal Drum Type



for the *COMING*

"Ore-processing" refers broadly to all kinds of ore, both metallic and non-metallic, and specifically to any operation calling for filtration whether in the mill, electrolytic plant or smelter.

Long ago—beginning in 1907, in fact—Olivers, Americans and Dorrcos proved their great usefulness in the washing of cyanide residues and in the dewatering of the various concentrates. Today, these three filters can be found throughout the mining world—countable by the thousands and handling all kinds of ferrous and non-ferrous ores. Olivers and Americans are strong, too, in the non-metallic field. These three filters pioneered

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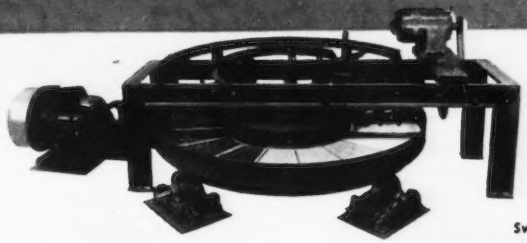
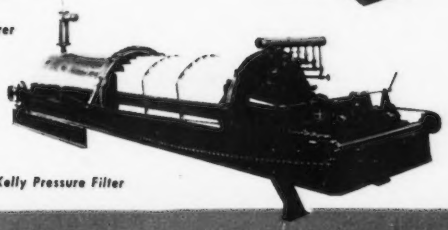
Proved Filters...

Oliver Horizontal Rotary Filter

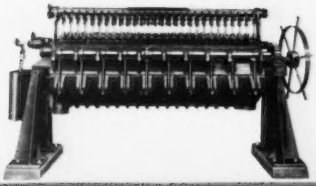


Sweetland Pressure Filter

Oliver Hopper Dewaterer



Kelly Pressure Filter



Developments in Ore-Processing

filtration for the industry. They are responsible for the high standards set.

But we didn't stop there. We didn't "rest on our laurels". We developed and perfected other types of filters that have a definite place in the broad field of ore processing.

Seven of our extensive line of filters, applicable to ore processing, are illustrated in the panel above. Your attention is called particularly to the Oliver Horizontal Rotary Filter which has some very useful filtration characteristics, particularly high dewatering rate and high "cake tonnage per filter area". The Kelly "Sulphur" Pressure Filter will be of interest to acid plants working on the pyritic ores and needing to supplement their supply of SO_2 by burning sulphur. This filter assures clean sulphur for the burner. The Sweetland Filter has numerous applications in electrolytic plants and smelters. It is industry's standard pressure filter. The Hopper Dewaterer is a simple continuous "drainer", aided by vacuum.

With these filters goes a world-wide engineering service and manufacturing facilities or connections in several countries. With these filters, too, goes an experience in ore filtration which began some 42 years ago.

UNITED FILTERS INC.

Melbourne
Hobart Duff, Pty., Ltd.

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E. L. Bateman, Pty., Ltd.

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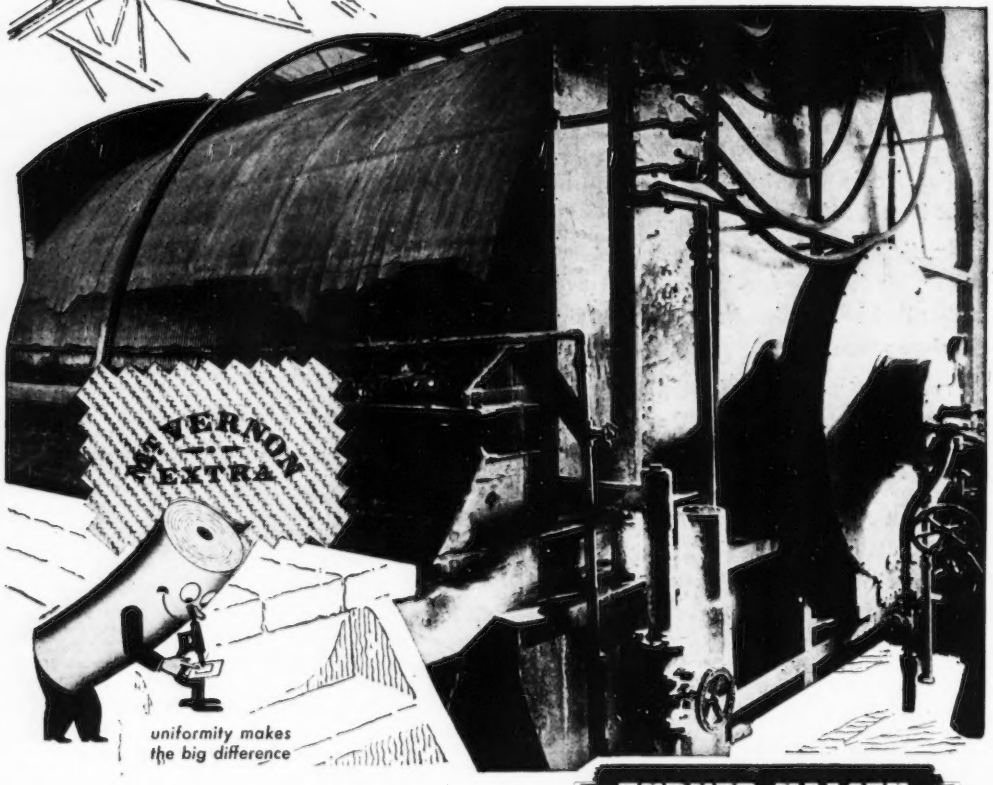
Uniformly Better Filtering with Mt. Vernon Extra

Mt. Vernon Extra filter fabrics are made from top grades of cotton and produced under rigid laboratory controls . . .

The result is Mt. Vernon Extra's high degree of uniformity—for more thorough filtering—greater clarification of filtrates—more efficient recovery of solids . . .

Mt. Vernon Extra has the ruggedness required to take the rough scrubbing and scraping that's necessary in filter-fabric cleaning . . .

For fabrics that give you more thorough, more efficient filtering and longer wear, specify Mt. Vernon Extra.



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This series of fine collectors is continually being developed and expanded to meet the problems of ore concentration throughout the world. We invite your inquiries concerning flotation concentration.

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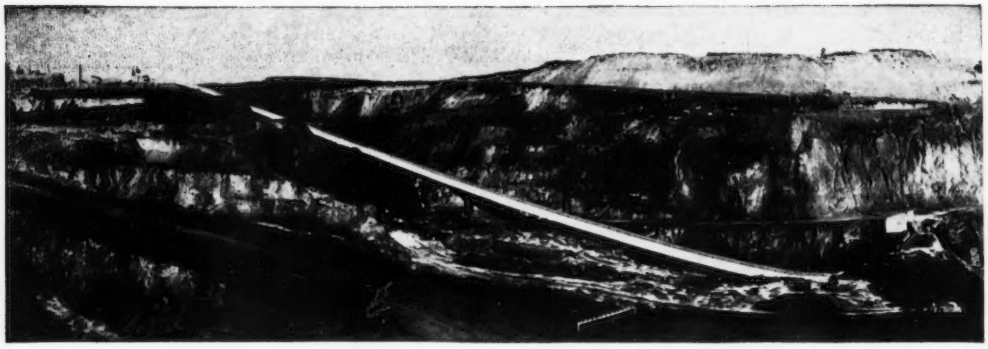
THE DOW CHEMICAL COMPANY

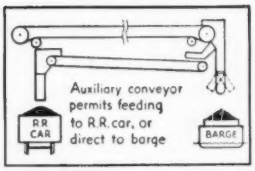
SAN FRANCISCO 4, CALIFORNIA, U. S. A.

PIONEER PRODUCERS OF XANTHATES FOR METALLURGICAL USE

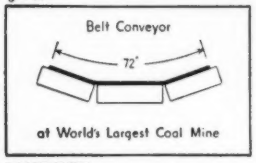


Above: 1700 ft. long belt conveyor in the mining industry. One of a number of Link-Belt slope belt conveyors installed on the iron range.

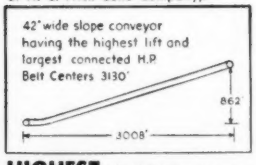
Why Link-Belt leads in belt conveyor engineering



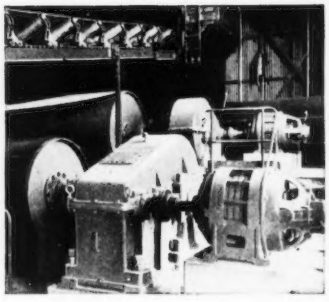
LONGEST belt conveyor in the mining industry (10,900 ft.) for a metallurgical coal mine in West Virginia.



WIDEST belt conveyor in the mining industry (72" belt), installed at the largest coal mine (Robena Mine of H. C. Frick Coke Company).



HIGHEST lift (862 ft.) in the mining industry for a Southern Illinois coal mine.



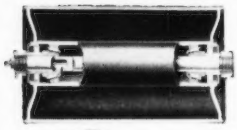
Terminal belt conveyor drive equipment at Robena Mine (above). The success of Link-Belt conveyor installations in raising production rates and cutting handling costs is due not only to the most advanced design and construction of Link-Belt manufactured components, such as carrying and return idlers, terminal and drive machinery, welded steel pulleys, and highly efficient speed reducers, but to broad engineering experience in integrating these elements most effectively.

LINK-BELT COMPANY

Chicago 9, Philadelphia 40, Pittsburgh 13, Wilkes-Barre, Huntington, W. Va., Atlanta, Dallas 1, Minneapolis 5, Denver 2, Kansas City 6, Mo., Los Angeles 33, San Francisco 24, Cleveland 15, Indianapolis 6, Detroit 4, St. Louis 1, Seattle 4, Vancouver, Toronto 8. 11.450

LINK-BELT *Belt Conveyor Idlers*

The Link-Belt "100" belt conveyor idler is the culmination of more than half a century of experience and development.

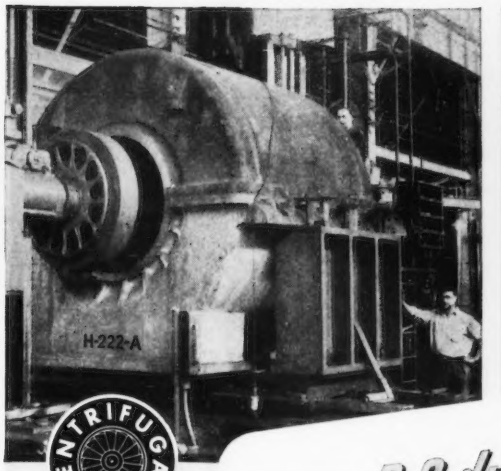


Illustrations above and to the left show the positive Grease-In-Dirt-Out Seal which conserves lubricant and prolongs bearing life . . . cross-section of roll, showing shaft, grease seals and roller bearings . . . tough malleable bracket in reinforced T-section to withstand load and impact.

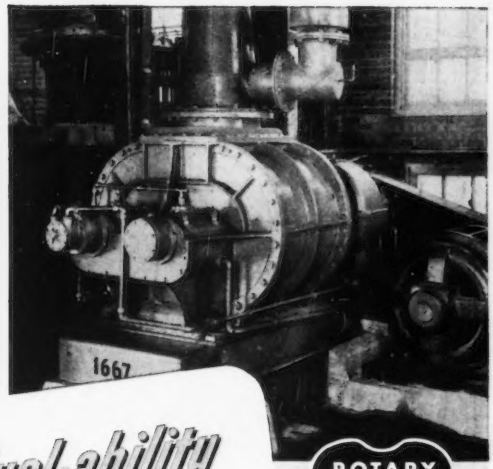
Link-Belt positive action self-aligning troughing idler. For details on Link-Belt belt conveyor equipment, ask for Book 1915.

LINK-BELT CONVEYORS

HANDLING EQUIPMENT . . . POWER TRANSMISSION MACHINERY



R-C Centrifugal Blower, with capacity of 69,300 CFM, being built in our plant.



R-C Rotary Blower, type RCD, capacity 6,200 CFM.

LET *R-C dual-ability* SETTLE THE QUESTION

If you are in doubt about whether Centrifugal or Rotary Positive units will do the best job of handling gas or air on any specific application, you can obtain an unbiased answer from R-C *dual-ability*.

Because we build both types, in wide ranges of sizes and designs, we can make sound comparisons and can recommend without prejudice the units whose capacities, pressures, drives and other characteristics are matched to the job, to deliver the best performance.

Only Roots-Connersville gives you this *dual choice*. It comes from 95 years of designing and building gas and air handling equipment, exclusively.

ROOTS-CONNERSVILLE BLOWER CORPORATION
907 Central Avenue, Connersville, Indiana

FOR HANDLING GAS OR AIR, CALL ON *R-C dual-ability*

No other manufacturer offers such a wide choice of equipment for handling gas and air:

Centrifugal and Rotary Positive Blowers, Exhausters and Boosters

•

Rotary Liquid and Vacuum Pumps

•

Positive Displacement Meters

•

Inert Gas Generators

•

You can depend upon the value of R-C *dual-ability*, because handling air and gas has been our *exclusive* business for 95 years.

★ ★ ★ ★ **ROOTS-CONNERSVILLE** ★ ★ ★ ★

BLOWERS • EXHAUSTERS • BOOSTERS • LIQUID AND VACUUM PUMPS • METERS • INERT GAS GENERATORS

• • ONE OF THE DRESSER INDUSTRIES • •

New GOULD "Z" Plate

BATTERIES STAY NEW LONGER

From Gould's modern laboratories and pilot plant comes a revolutionary new plate design that greatly improves battery performance. The new Gould "Z" Plate means that Gould batteries stay new longer! Here's why:

1. Solid, non-porous positive grid.
2. All grid members are heavy with same cross section.
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Available shortly in all "Thirty" and "Kathanode" types. Ask for literature on how Gould's new casting techniques improve battery performance.

The Gould "Thirty"
More than ever—America's
Finest Motive Power Battery.

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TRENTON 7, NEW JERSEY

Always Use Gould Automobile and Truck Batteries

No Twist— No Stress— No Strain

with

Mack Six-Wheelers

That's because only Mack six-wheelers have the advantage of Mack's famed Balanced Bogie. Here's an outstanding development that means unmatched flexibility . . . mastery of the toughest terrain without stress or strain.

The exceptional flexibility of the Mack Balanced Bogie insures equal traction, even tire loading and uniform braking on all four wheels. Exclusive Mack Power Divider assures traction at all times, regardless of terrain.

Simplicity and rugged strength are typified in the functional construction of the Balanced Bogie. Maintenance requirements are reduced to a minimum. Outside of the brake system only four points on the assembly require lubrication. No place in the suspension ever needs adjustment.

For detailed information on how this and other Mack features can cut costs and increase profits on your particular job, see your nearest Mack branch or dealer.

IT'S PART OF THE LANGUAGE

Built Like a **Mack** *Truck*

Mack Trucks, Inc., Empire State Bldg., New York 1, N. Y. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

MAGNETIC *and* ELECTRICAL SURVEYS *from the* AIR

- ***Save time and money***
- ***Focus on right area***
- ***Eliminate unlikely areas***
- ***Pinpoint possible areas***

In ONE DAY you can easily survey BY AIR from 150 to 450 linear miles—as compared to the slow and laborious ½ to 2 miles a day of ground operations.

SURVEYS IN DETAIL OF THE EARTH'S MAGNETIC FIELD carried out from the air by means of helicopter or other low-flying aircraft are now available to the mining industry. The cost varies between $5-20 per linear mile flown and magnetic field recorded. The cost depends on the size of the area to be covered. Similar surveys carried out on the ground, giving equal amount of detail, would cost some $60-$80 per linear mile, plus the cost of cutting and staking the lines of some $25-$50 per mile.

Some Cost Figures

AIRBORNE OPERATIONS

	Cost per linear mile
Helicopter—150 linear miles a day	1 day $20—1 month $10
Plane —450 linear miles a day	1 day $15—1 month $5

	Cost for square mile (lines 300 ft. apart)
Helicopter—1 day $360—1 month $180	
Plane —1 day $270—1 month $90	

ELECTRICAL SURVEYS are now carried out from a boat or from low-flying aircraft to determine the character of conducting bodies as well as their depth from surface.

The cost of electrical surveys is about the same as for the magnetic surveys from the air, and these figures compare more favorably with ground surveys since electromagnetic surveys on the ground cost some $150-$250 per mile surveyed, plus the $25-$50 for preparing lines for the survey.

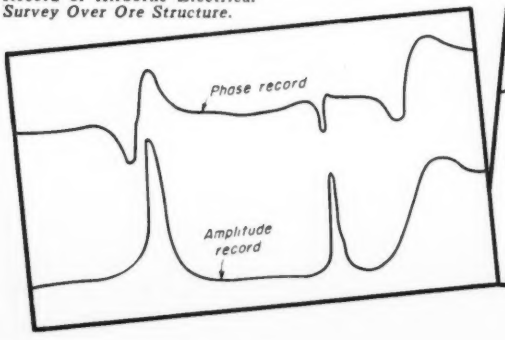
MAGNETIC AND ELECTRICAL SURVEYS MAY BE DONE SIMULTANEOUSLY FROM THE SAME CRAFT, thus making the exploration doubly informative and fast.

LUNDBERG EXPLORATIONS LIMITED

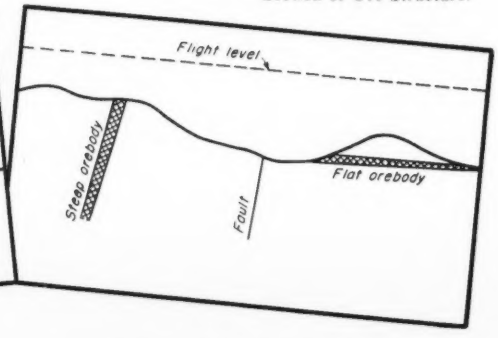
AND SUBSIDIARY COMPANIES

VICTORY BUILDING **TORONTO 1, CANADA**

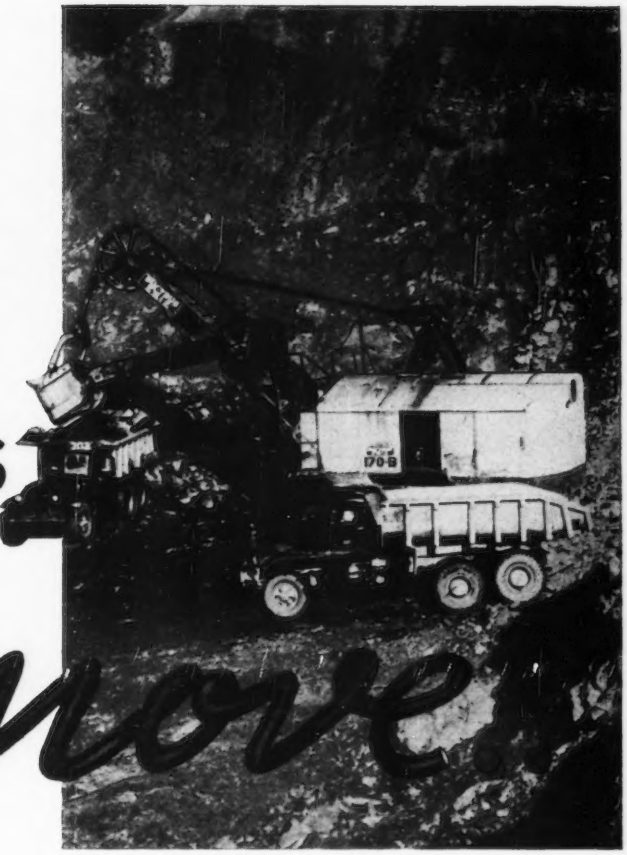
Record of Airborne Electrical Survey Over Ore Structure.



Section of Ore Structure.



TRUCKS and SHOVELS keep on the move



when you detonate with PRIMACORD

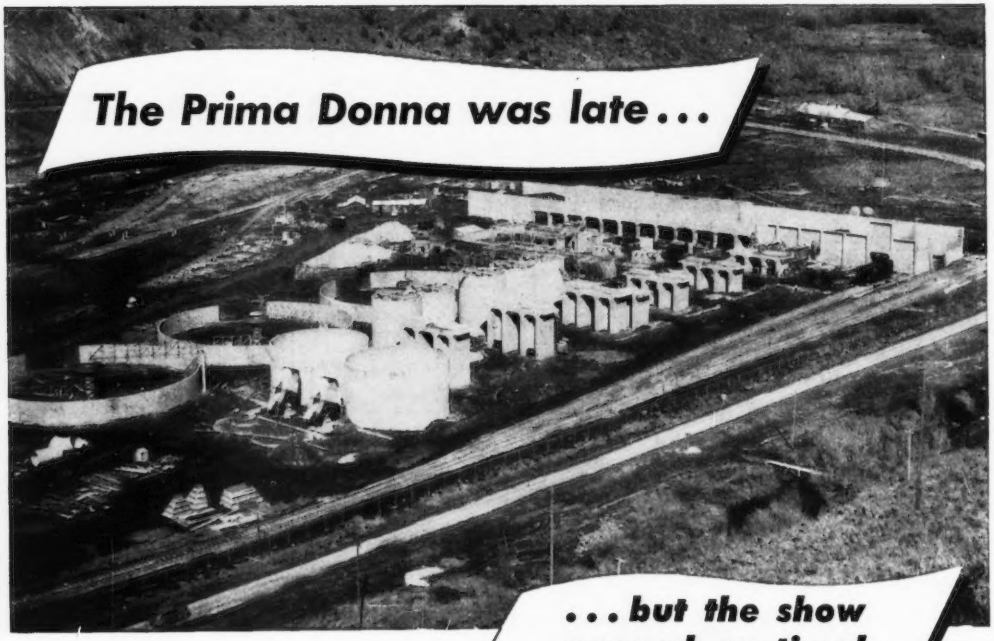
You can figure on better digging when you shoot with Primacord. *Operations speed up all along the line.*

Primacord does this with a combination of forces that team up to give you more complete fragmentation. Down-hole lines initiate the whole charge instantly, from top to bottom, with all the power of primer cartridges. Main lines can be laid out so that front holes go a split second before succeeding ones, allowing for planned relief of burden.

You can get Primacord, wound on easy-to-handle spools, in a grade to meet every blasting condition. It's insensitive to stray currents, and hooks up as fast as you can tie square knots or half hitches. Ask your supplier about Primacord, or write direct to The Ensign-Bickford Company, Simsbury, Connecticut. P-23

PRIMACORD-BICKFORD Detonating • Fuse •

Also Ensign-Bickford Safety Fuse Since 1836



During construction of the Ideal Cement Company's plant at Devil's Slide, Utah, it was found that structural steel deliveries might delay completion of the plant. Therefore, concrete was poured for the project as a whole, before the arrival of the steel—as shown by the above photograph. By so doing, serious delays were avoided.

22,000 cubic yards of concrete were poured. Capacity of this wet process cement plant is 4,000 barrels daily.

Ability to make major on-the-ground shifts in projects of this magnitude, avoiding delays without adding materially to overall costs, is a good example of the "know-how" you can expect from Stearns-Roger.

UNDIVIDED RESPONSIBILITY
- ENGINEERING
- DESIGNING
- MANUFACTURING
- CONSTRUCTION

Stearns-Roger

THE STEARNS-ROGER MFG. CO. DENVER COLORADO

replacements are far less frequent when you use

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"HERCULES"

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RED-STRAND

WIRE ROPE

because—

Its strength...its toughness...its unusual endurance—add up to longer wire rope life

These essential life factors are not a matter of chance. They are the result of combining "HERCULES" quality and PREFORMING. This is a winning combination as Preforming is the process that increases the life of a wire rope, by freeing it of internal stresses. It also makes a wire rope easier, quicker and safer to handle.

"HERCULES" RED-STRAND the DEPENDABLE WIRE ROPE for any TOUGH JOB

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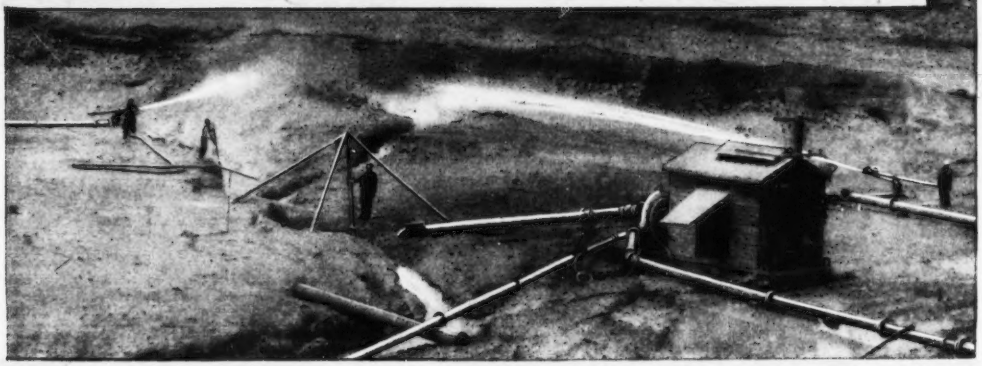
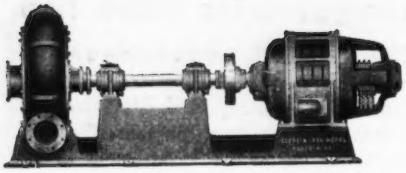
Any way you figure...

Dependable GIW PUMPS

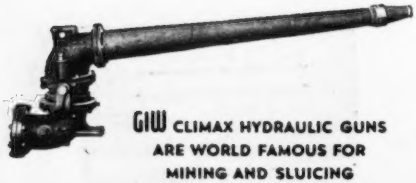
do the job **Efficiently** *and at* **Lower Cost**



GIW PUMPS Cost Less to Buy, Less to Keep Up, and Less to Operate



RIGHT HAND BOTTOM DISCHARGE SAND AND DREDGE PUMP WITH MOTOR



GIW CLIMAX HYDRAULIC GUNS ARE WORLD FAMOUS FOR MINING AND SLUICING

Let GIW pumps solve the problem of economically moving solids. Here are three reasons why many very successful operators use GIW pumps exclusively:

1. They are so simple that even unskilled labor can operate or assemble them efficiently and easily.

2. Georgia Iron Works makes sand and dredge pumps, hydraulic guns and related parts, and nothing but these items. The rugged dependability of GIW pumps is a matter of record since 1891. GIW parts are made to wear and wear under severe tests. Enjoy the satisfaction of using the tried and true GIW pumps.

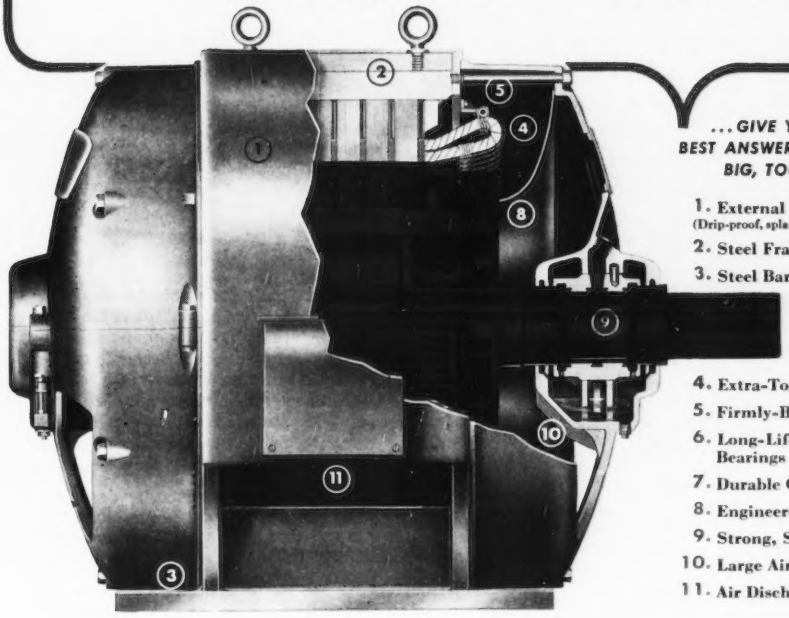
3. GIW pumps are the lowest cost pumps of proven quality obtainable. Replacement parts cost much less. Any way you figure, durable GIW pumps do the job efficiently and at lower cost. May we take care of your requirements? Write for descriptive literature.

GEORGIA IRON WORKS CO.

EST. 1891

PHONE 4-1428 • P.O. BOX 1128 • AUGUSTA, GEORGIA

Eleven BIG features of E-M Induction Motors



...GIVE YOU THE ONE BEST ANSWER FOR HANDLING BIG, TOUGH DRIVES

1. **External Protection** (Drip-proof, splash-proof or fully enclosed)
2. **Steel Frame**
3. **Steel Bar Feet**
4. **Extra-Tough Coils**
5. **Firmly-Braced Coil Ends**
6. **Long-Life, Cool-Running Bearings**
7. **Durable Cage Windings**
8. **Engineered Ventilation**
9. **Strong, Stiff Rotor**
10. **Large Air Intake**
11. **Air Discharge at Feet**

● Ever lock fenders with a commercial taxicab? Chances are your passenger car came off second best, because taxicabs are specially built to take that kind of punishment.

Big motors have to take punishment, too. They must have greater ruggedness and stamina than small motors. That's why it's significant that E-M Heavy-Duty Induction Motors are built by big-motor specialists—the same people who have made E-M Synchronous Motors a byword for toughness and reliability.

Just look at the design and construction features shown above. Each is a factor in the dependable performance of E-M Heavy-Duty Induction Motors, year in and year out. They explain why maintenance is held at a minimum when an E-M Heavy-Duty Induction Motor is on the job.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

You'll enjoy reading our special issue of THE SYNCHRONIZER, "The ABC of Large Induction Motors." This 32-page booklet is written by G. L. Oscarson, our Chief Application Engineer, and presents a comprehensive, practical, fact-filled treatment of Induction Motor fundamentals. It is lavishly illustrated with installations, photographs, cutaway views of squirrel-cage motors, and has nearly fifty graphs with explanatory figures accompanying the text. Get a copy from your E-M man, or write us direct.

1300-TPA-2084

E-M

SPECIALISTS IN BIG MOTOR ENGINEERING

DINGS

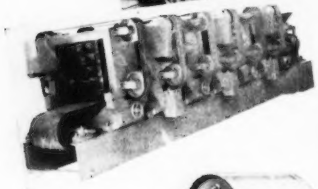
magnetic equipment for every mining requirement!

Dings Rectangular Electromagnet provides maximum iron removal above belts or chutes. Triple pole design for great magnetic strength and depth of penetration. Maximum magnetic strength across entire magnet face. Easily installed in any position. Low operating cost . . . trouble free . . . complete range of sizes.

(Right) Induced Roll Separator purifying sand.

Battery of Crockett Separators concentrating magnetite. (Left)

Magnetic Detector signals presence of tramp iron. (Right)



NEW, powerful Cross Belt Separator — with higher selectivity — for concentration and purification (Above)

NEW, powerful, non-electric Alnico Perma-Pulley for purifying, cobbing, protecting crushers, pulverizers, etc. Magnetic permanence guaranteed for life of installation. (Above)

Wherever crushers must be protected against tramp iron, wherever magnetic separation can contribute to the beneficiation of ores, you will find Dings magnetic separators specially designed to meet the requirements of the job. Dings magnetic separators have played an important role in making the extraction of many minerals possible and economically feasible. Shown here are a few of the machines which Dings has pioneered exclusively for the mining industry for the following purposes:

CONCENTRATION—everything from specially designed pulleys for cobbing nickel ores to powerful induced roll and cross belt separators for concentrating manganese, tungsten, chrome, titanium and many other minerals.

PURIFICATION—removing small amounts of feebly magnetic impurities with super high intensity separators. Minerals treated include feldspar, silica sand, salt, bauxite, barytes, nepheline-synenite, gypsum.

CRUSHER PROTECTION—magnetic pulleys, pulley type separators, drums, suspension magnets, spout magnets and magnetic detectors are all widely applied for arresting tramp iron ahead of crushing equipment.

WET TYPE SEPARATORS—Dings has pioneered in the development of wet type separators for concentrating magnetite and for use in new processes for concentrating low grade ores. *Ask for complete details of Dings Separators for Heavy Media Process Plants.*

Take advantage of Dings equipment and experience. For practical recommendations, submit your requirements with 25 lb. samples of material to the Dings Laboratory for testing and analysis. Literature on request.

DINGS MAGNETIC SEPARATOR CO.

4716 W. ELECTRIC AVENUE, MILWAUKEE 14, WISCONSIN

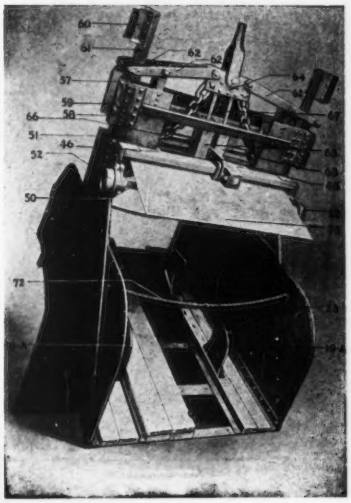
"Magnetic Separation Headquarters Since 1899"

Dings

"HIGH INTENSITY"

COST REDUCING

Lepley MINE EQUIPMENT

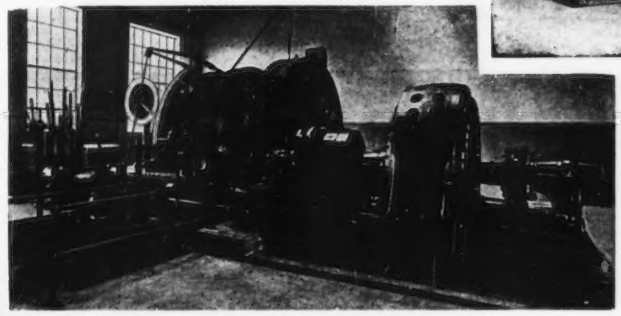


For nearly 50 years we have pioneered in the construction of equipment designed to stand up under the hardest kind of service—and low enough in original cost to keep overhead and depreciation within reasonable limits.

On this page is just a sample of the operating equipment we supply. Other items available: Steam or Electric Hoists and Haulages, Self Dumping Safety Cages, Bottom Discharge Skips, Overturning Skips, Overturning Cage (End Dump), Solid Car Side Dump Cage, Bottom Loading Skips, Hard Steel Liner, Head Sheaves, Shaft Bearings, Rotary Dumps, Mine Fans, Mine Pumps, Revolving Slate Dump Larries, Rectangular and Beehive Coke Oven Machinery, Fort-Pitt Mine Equipment, and allied equipment.

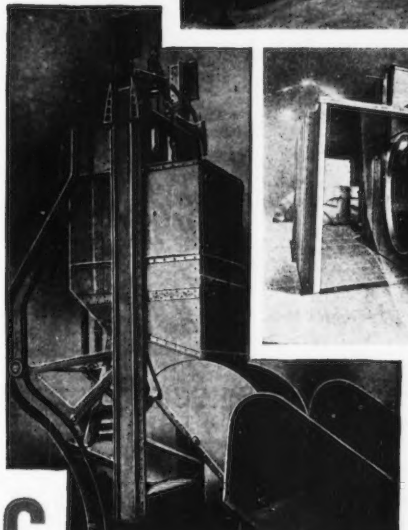
We have no "standard" hoist line — each design is based on a study of your needs. Steam and electric shaft and slope hoists available.

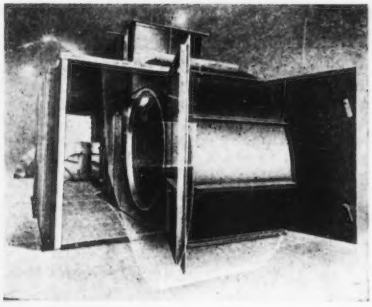
HOISTS



CAGES

Simplicity, ruggedness, safety and low maintenance are stressed in the design of Lepley Cages —your answer for efficient handling.





FANS

Reversible supply or exhaust fans to suit your mine. Sizes up to 35 ft. in dia. by 8 ft. face. Produces 700,000 cu. ft. min. at 10.3 inches water gauge.

SKIPS

Leading coal mining companies testify — Lepley Skips meet rugged requirements at lowest cost . . . tops for efficient material handling.

Write—ASK FOR DESCRIPTIVE BULLETINS

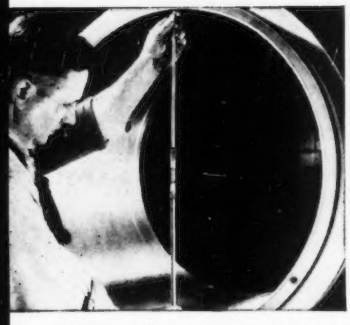
SEND US YOUR PROBLEMS

CONNELLSVILLE MFG. & MINE SUPPLY CO. CONNELLSVILLE PENNA.

Layout Man Illustrates Adaptability of Lufkin Inside "Mikes"...

Lufkin tools meet exacting requirements of layout man, John Adams, employed for 14 years at the Mesta Machine Co., Pittsburgh, Pa.

● Every Lufkin Precision Tool has features that are of practical aid to skilled craftsmanship. Lufkin Inside Micrometers measure I.D.'s. from 1½" up. Each rod is marked with its length and rods can be added to either or both ends of the micrometer head.



Tubular, light weight measuring rods can be added to both ends of the micrometer head—thus keeping the head central and in balance—assuring more sensitive "feel" and precise readings.

Ground threads on micrometer heads assure smooth operation and greater accuracy. Rods and caps ground to extremely close limits to permit interchangeability. Heads have "Rapid Reading" (each thousandth numbered) to eliminate errors in reading. Lock nut holds measurement firmly.

Flat surface on knurled collar opposite reading line makes it easy to instantly find reading line even in poor light.

It is easy to adjust micrometer head. Extension rods that show wear are also adjustable by turning hardened and ground plug either into or out of the rod.

Buy **LUFKIN**

PRECISION TOOLS
TAPES • RULES
From your distributor

Write Dept. EM for fascinating booklet, "The Amazing Story of Measurement." Enclose 10c (no stamps) to cover handling and mailing.

THE LUFKIN RULE CO.

Saginaw, Michigan • New York City • Windsor, Canada

HOW WORN IS "WORN OUT"?

STOODY HARD-FACING salvages many types of heavy equipment normally junked because of excessive wear . . . not only reclaims it for added service but often improves life and performance over new equipment.

TAKE CRUSHER MANTLES AND CONES, for example. When worn beyond limits, sizing of material is no longer efficient. Rebuilt to within ¼" of original size with STOODY MANGANESE, and overlayed with STOODY SELF-HARDENING **21**—or its equivalent in Stoody automatic wires (Stoody **121**)—original dimensions are restored and equipment is salvaged. But what's more, *wearability* is approximately *doubled!* Crusher output is increased as much as 50% and sizing more uniformly maintained. Nor is this a one-shot application . . . as the hard metal finally wears away, it can be reapplied with equal results. STOODY ALLOYS *are your answer to low-cost maintenance on heavy equipment investments!*

NOTE: FOR RE-BUILDING, cones should have these minimum wall thicknesses: 4' cone, 1½"; 3' cone, 1"; 2' cone, ¾".

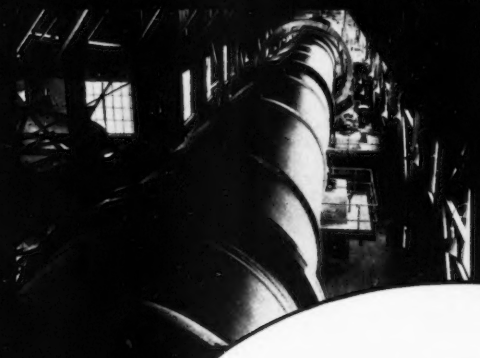
When confronted with wear problems, consult your Stoody Dealer. His experience, plus the knowledge of our field engineers, is yours for the asking.

STOODY COMPANY
11940 EAST SLAUSON AVENUE
WHITTIER, CALIFORNIA

This GYRATORY CRUSHER HEAD has seen plenty of action, yet is kept on the job with Stoody Self-Hardening **21**, applied manually.

4' STANDARD CONE CRUSHER was built up and hard-faced with automatic electric welding equipment. Stoody **121**, supplied in large coils for continuous application, provides the wear protection.

ROTARY SINTERING KILNS



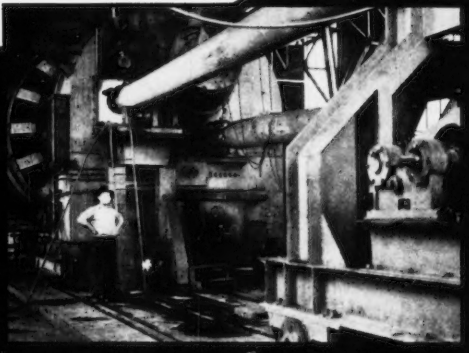
Iron ore, manganese ore, phosphates of all sizes, flotation concentrates and flue dust alone or mixed, can be sintered regardless of moisture and carbon content.

Sintering temperature easily regulated and maintained as desired, producing sinter of proper porosity and hardness, thus saving blast furnace fuel.

Materials sintered without fines, eliminating screening and rejects.

Any available gas, oil or pulverized solid fuel may be used.

Low power consumption—7 to 8 kwh per ton of sinter.



F. L. SMIDTH & CO.

11 WEST 42ND STREET NEW YORK, N. Y.

IT'S HERE

AN OUTSTANDING NEW TIREX SHUTTLE CAR CABLE that's geared to give longer service, safer operation, and more-dependable performance through a new and exclusive feature — **TIREX Ribbed, or Gear-Shaped, Insulated Conductors.**

TIREX Ribbed Insulated Conductors are a radical improvement in the construction of Shuttle Car Cables. Gear-Shaped, they firmly interlock with the jacket so that even continual twisting of the cable cannot pull them out of position.

Think what this means! No twisted or overlapped conductors. None of the costly failures they cause. And this TIREX insulation is suited for use at high copper temperatures to assure safe, trouble-free operation during temporary overloads.

Add to these features the advantages provided by the cured-in-lead Selenium Neoprene jacket — resistance to crushing and runovers, to flame, acids, oil and heat — and you'll begin to see how much this new cable can mean to your overall operating efficiency.

Compare it with the cables you now have in use. You'll find a great difference. But remember! The greatest difference lies in tons of coal produced and dollars saved... **The new TIREX Shuttle Car Cable multiplies both!!**

For complete information and dimensional data write for folder 1007.

Simplex-Tirex CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

The method of the "future" here TODAY...

S F
SINK FLOAT

ACCURATELY CONTROLLED

HEAVY DENSITY CONCENTRATION

Many millions of tons of ores have been treated by the H. H. Sink Float Process since the first commercial plant went into operation more than ten years ago.

Another large operator selects

The Huntington Hebelein Sink & Float Process

The Consolidated Mining & Smelting Company of Canada, Ltd.

is now operating a fine new H. H. Sink Float Plant treating the output of the famous Sullivan ore body with improved metallurgical results at the Sullivan Concentrator.

New installations (now operating under construction or ordered) will bring the world-wide capacity of H. H. Sink Float Plants to approximately nine million tons of ore annually.

MORE EFFICIENT S F **MORE ECONOMICAL**

- Rejects coarse waste without grinding it.
- Produces coarse market concentrate.
- Permits nonselective mining.
- Treats metallics and nonmetallics.
- Treats mine ores, dumps, fill, development ore.
- Serves existing and new installations.
- Reduces Capital and Operating Costs.

THE SINK AND FLOAT CORPORATION

EMPIRE STATE BUILDING NEW YORK 1, NEW YORK

EXCLUSIVE
Roll Type Throttle Control

EXCLUSIVE
Push Button Air Bleeder Valve

EXCLUSIVE
Cylinder Mounting for Positive Safety . . . Longer Service Life

NEW Thor SINKER LEG

45% MORE FOOTAGE AT FAR LESS COST!

Here's real savings in labor . . . man hours . . . and drilling costs . . . and 45% more drilling footage by actual tests!

The miner can carry the entire setup—Thor Sinker and Thor Leg—into the smallest tunnel or closest corner, set it up in an instant, start the hole . . . and then let Thor do the work! All he does is control the *constant pressure* feed by operating two simple throttles—*the only automatic controls in leg operation!*

Think of the savings . . . both in operating costs and air consumption. With carbide bits the Thor Leg can replace drifters—and heavy mountings on scores of heavy duty operations . . . can drift in tunnels where drifters won't fit. Write today for catalog data.

FULLY AUTOMATIC—A quick, easy setup—just start the hole—set the leg at any angle between 30 and 45 degrees. . the leg does all the lifting—all the constant pressure feeding . . . control the feed with a turn of the wrist!

INDEPENDENT PNEUMATIC TOOL COMPANY
AURORA, ILLINOIS
Export Division: 330 West 42nd Street, New York 18, N. Y.

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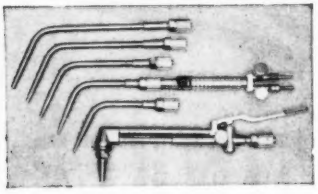
Thor PORTABLE POWER TOOLS

PNEUMATIC TOOLS • UNIVERSAL AND HIGH FREQUENCY ELECTRIC TOOLS • MINING AND CONTRACTORS TOOLS

YOUR SUPPLY DEPOT.....

for oxyacetylene flame and electric arc equipment, supplies and accessories

NEW AIRCO 700 WELDING TORCH. The *new* Airco 700 is suitable for 90% of your welding and brazing work. It is available with tip assemblies ranging from Nos. 00 through 10 . . . with an individual mixer drilled for each particular tip. This means *better flame control*—there is no sputtering, and better welds result. The *new* "700" also features:



. . . **Wide operating range**—can weld everything from thin sheet metal up to two inch plate, and when equipped with a multi-flame tip, it's tops for silver and aluminum brazing.

. . **Perfect balance**—lightweight, with ⅜" I.D. hose, it eliminates operator fatigue.

. . **Low maintenance cost**—its long-wearing monel head means fewer replacements, and reduced maintenance because rarely is reseating required.

With the addition of a cutting attachment, the new "700" can be easily converted to handle general shop cutting work.

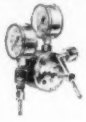
FOR HEAVIER JOBS, Airco also has available a new Series 800 Torch which is comparable to the "700" in both appearance and operating characteristics.

These outstanding *new* welding torches are but two of the many included in Airco's complete line of torches for every conceivable gas welding and cutting application.

LOW-COST AIRCO No. 10 RADIAGRAPH GAS CUTTING MACHINE. The No. 10 Radiagraph is a motor-driven, portable gas cutting machine that cuts in straight lines of any desired length, at speeds from 4" to 50" per minute. It also cuts arcs up to 42½" radius, circles from 3" to 85" in diameter, and bevels up to 40° angle. It weighs only 41 pounds net, and is easily moved from job to job.

Other types and styles of portable machines are also available, as well as a wide variety of stationary types, which operate on the pantograph principle. These machines include the popular Planograph, Oxygraph and Travograph, and are designed to cut straight lines, rectangles, circles and irregular shapes from thinnest steel sheet to thicknesses of 12" or more.

AIRCO TWO - STAGE PRESSURE REGULATORS. These popular regulators for use with oxygen, acetylene, hydrogen, or nitrogen require but one adjustment . . . the first. Once set at the correct operating pressure, they deliver a constant, nonfluctuating flow of gas from start to finish of cylinder discharge. Drops in cylinder pressure are automatically compensated for, thus enabling the operator to devote his full attention and skill to the job at all times.



Airco single - stage regulations are also available for all gas pressure uses.

AIRCO GAS WELDING AND CUTTING SUPPLIES. Airco also produces a complete line of supplies for every phase and stage of gas cutting and welding. Included in the line are: welding rods, fluxes, cylinder trucks, tip cleaning drills, sparklighters, gloves and goggles.

NEW
AIRCO HARDFACING ALLOYS
add 2 to 25 times
LONGER SERVICE LIFE
to new and worn parts

Whatever your wear problem—heat, corrosion, impact or abrasion—Airco's New Hardfacing Alloys will give you the most effective solution. With one application of these wear-retarding materials, the service life of both new and worn parts is increased, in some cases, at least 25 times.

NEW WILSON "HORNET 36A" DC WELDER. The Wilson "Hornet 36A" Arc Welder is the newest member of a famous arc welding machine family. It is a heavy - duty, light - weight machine designed to furnish smooth, steady current for every DC arc welding job—even under severe operating conditions.

The "36A" features simplified control of current output by means of a sturdy hand-wheel mounted on the control cabinet. Close calibration of the current dial eliminates the need for meters. Easy reversal of the polarity of the welding terminals is provided by a sturdy polarity switch. 200, 300 and 400 ampere sizes are available.

Other arc welding machines in the Airco line include the production-proved Wilson "Bumblebee" AC welders, known for their ease of operation and wide work range. These machines feature improved electrical efficiency at rated loads, wide current range, low open circuit voltage (75 volts), vastly improved power factor, quiet operation and minimum maintenance. In fact, there is a Wilson machine for every AC or DC welding purpose.

AIRCO AC/DC ELECTRODES (Including Stainless Steel and Hardfacing Alloys). Time - tride and production-tested, Airco's vast line of electrodes is engineered to supply the right answer for every welding problem. They range from general-purpose, mild-steel electrodes through the new special electrodes for welding "difficult" metals and alloys, and generally are available in both AC and DC types.

AIRCO ARC WELDING ACCESSORIES includes helmets, electrode holders, cable, clamps, gloves, brushes, and other items.

GASES

AIRCO OXYGEN, ACETYLENE AND RARE GASES are known throughout industry for their purity, economy and operating characteristics.

CARBIDE

NATIONAL CARBIDE (in the red drum) is made from the finest available coke and limestone. It is evenly sized and dust-free, and gives a high, uniform yield of acetylene gas.

For more information on the products on this page, as well as those making up Airco's complete line, write your nearest Airco Office, or Authorized Airco Dealer.

AIRCO

AIR REDUCTION

60 East 42nd Street, New York 17, N. Y.

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for the big job
...or the small

there's an SKF pillow block for every application

SKF Spherical Roller Bearing Pillow Blocks, in a wide range of standard sizes, are designed for bearing protection under various loads and speeds.

In industrial and marine equipment of all kinds, they keep SKF Bearings rolling smoothly, continuously and economically . . . seal the bearings against dust, scale and water . . . send maintenance costs 'way down.

To insure long trouble-free operation, specify SKF Bearings by ordering SKF Pillow Blocks to match. SKF Industries, Inc., Philadelphia 32, Pa.

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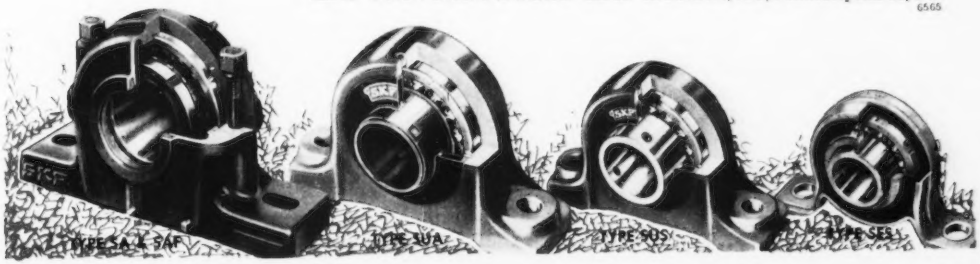


THE MILFORD Carbide ROCK BIT

THE *ENGINEERED* BIT

THE MILFORD BIT *offers:*

- Longer Total life
- Fits Standard Rods
- Sizes ranging from 1⅝ to 2½" dia. in ⅛" increments
- Lowest costs per foot of rock drilled

Advantages:

- Reduce drilling costs 50 to 60% over steel bits
- Increased drilling speed 20% or more
- Drill the hardest rock
- Reduces tapered holes
- Smaller diameter holes are easily drilled
- Longer drilling between grinds

THE MILFORD BIT has been developed under severe testing conditions using heavy pneumatic equipment and drilling the hardest rock.

THE MILFORD BIT is guaranteed against defects in workmanship and material.

SPECIAL APPLICATIONS:

If you have special drilling problems not covered by our standard line—write our engineering department giving details. We have developed many new uses of tungsten carbide in the pneumatic field.

Instruction Sheet:

Write for our resharpening data and also for instructions on the proper use of THE Milford Bit.

MILFORD TOOL COMPANY

110 GULF STREET **MILFORD, CONNECTICUT**

Announcing

PENNSYLVANIA CRUSHER COMPANY

DIVISION OF BATH IRON WORKS CORPORATION

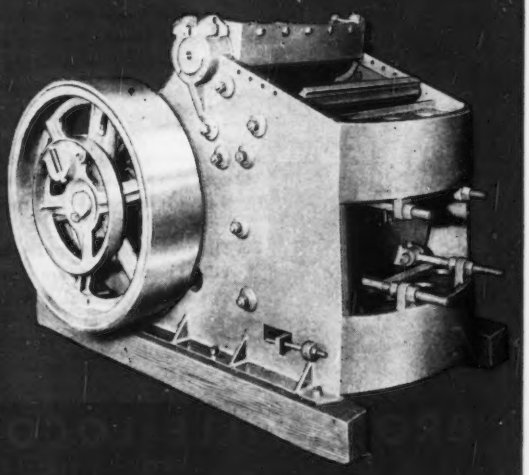
LIBERTY TRUST BLDG., PHILADELPHIA 7, PA.

New York • Pittsburgh • Chicago • Los Angeles • Birmingham—Associated with Fraser & Chalmers Engineering Works, London

Exclusive Eastern Manufacturer and Distributor of . . .

KUE-KEN JAW CRUSHERS

. . . Crushing without rubbing



Here is the one jaw crusher that "crushes without rubbing." The Kue-Ken crushes by *pressure only*, with no rubbing and minimum abrasion. The motion or path of travel of the jaw plates is squarely against the rock, instantly gripping and crushing without any rubbing action. Kue-Ken Jaw Crushers meet the most difficult crushing requirements of mine, quarry and industrial plant in a manner that sets them far apart from ordinary jaw crushers. Send for bulletin No. 5011.

Manufacturers of a complete line of crushing equipment • Hammermills • Single Rolls • Bradmills • Jaws • Gyracones • Granulators • Impactors • Bradford Breakers

Brookville
LOCOMOTIVES

COST LESS

LESS to buy ... Brookville can offer greater value and performance per dollar because Brookville uses high grade power plants produced economically in quantity by the leading manufacturers of heavy duty tractor engines, namely: International Harvester, Caterpillar and Ford.

LESS to operate ... Fuel costs are kept down by efficient Diesel power plants; and cost per ton is held to a minimum by high speed operation through four and five speeds in both forward and reverse.

LESS to maintain ... The standard, nationally-known power plants with which Brookville Locomotives are powered can be inexpensively serviced at authorized local service stations throughout the world.

Send for literature 47-1

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MINERS APPROVE safety features of "MS" Delay Electric Blasting Caps. These caps pull rounds clean . . . leave no dynamite in muck. They reduce concussion, vibration and timber damage.

EASIER PRIMING—"MS" Caps are easy to insert. Come in fourteen clearly marked delay periods, from 25 to 500 milliseconds. Abrasion-resistant, non-kinking nylon insulated wires prevent current leakage.

CAPS ARE ideal for rotational shooting—in wet or dry work. Have water-resistant rubber plug closures, and wires with aluminum foil shielded shunts. Try "MS" Caps in your mine—they may save you money.

ASK ANY DU PONT Explosives representative for complete information about Du Pont "MS" (Millisecond) Delay Electric Blasting Caps. He'll be glad to help you with any blasting problem you may have. E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

DU PONT EXPLOSIVES

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MEMO TO PRESIDENTS WHO WATCHED THE BAND GO BY!

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Though the formal spring campaign to sell Bonds is over, any company can still move forward with the parade. Right now thousands of companies are putting *additional push* behind their Payroll Savings Plans. Managements of many companies that have not yet participated are *now installing* the Plan.

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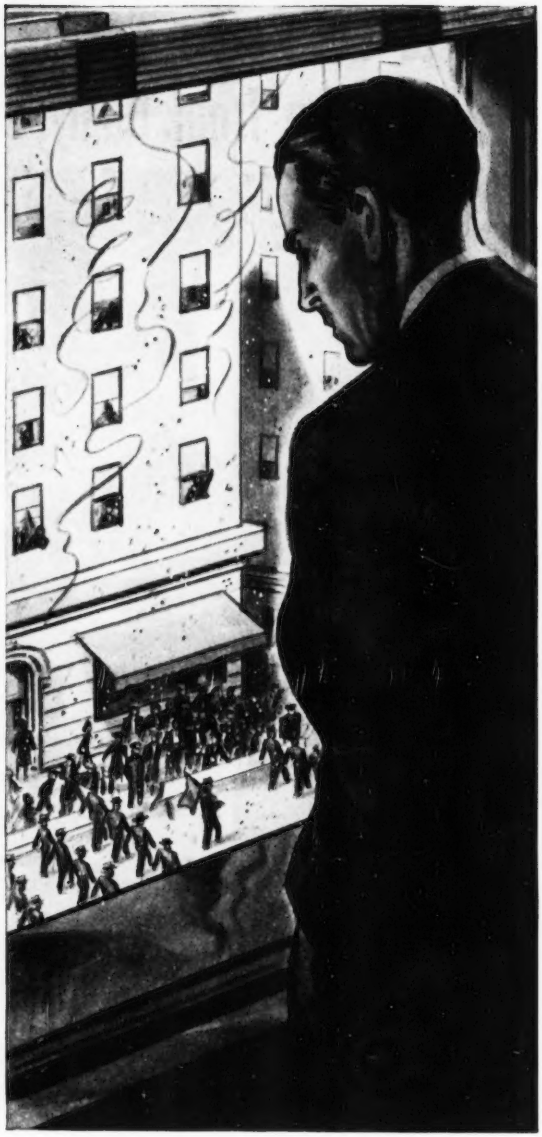
It's just as easy to take action now as when the campaign was at its height. Just call your Treasury Department's State Director, Savings Bonds Division, and ask for the material that helps to get a Payroll Plan started or to keep it rolling.



The Treasury Department acknowledges with appreciation the publication of this message by

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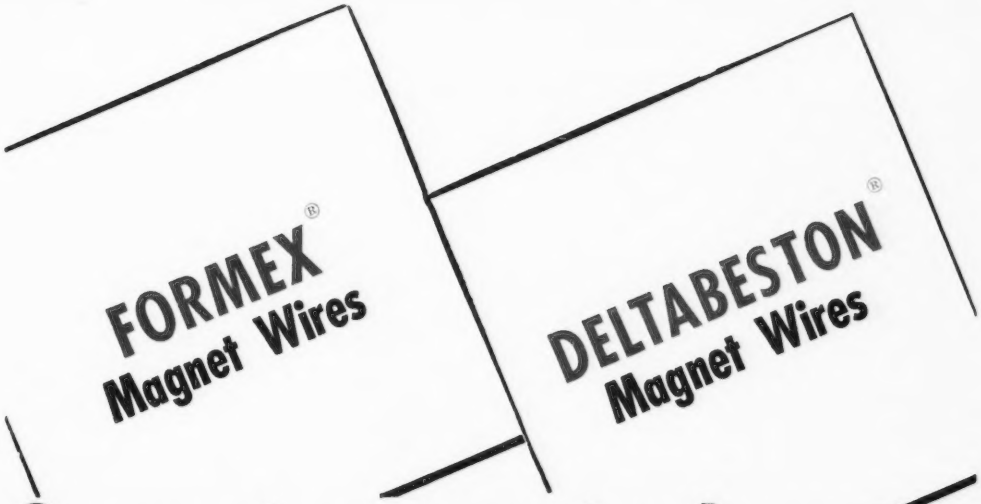

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Contact your G-E construction materials representative or distributor for detailed information about this complete magnet wire line. For the latest booklet on General Electric magnet wires, write to Section W40-732, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

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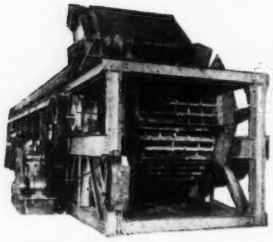

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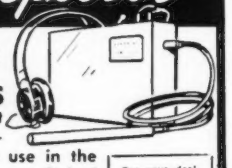

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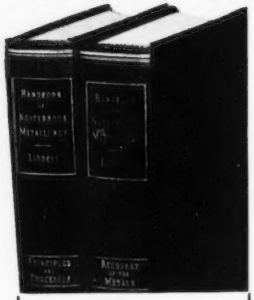

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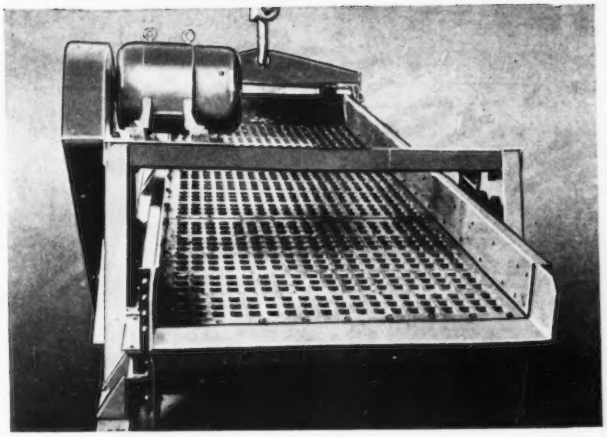

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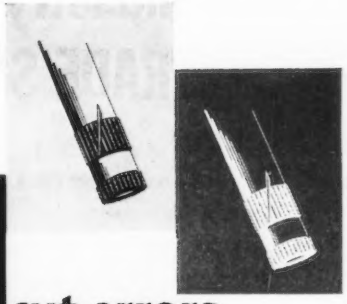

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If there is

something you want . . .

that other readers of this paper can supply

or —

something you don't want . . .

that other readers can use, advertise it in the

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(Classified Columns)
of this paper

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And they are right.

The customer also pays for your power supply, your production tools, your plant maintenance, your salaries. All these are figured into the price of your product, along with the cost of your advertising.

Does this mean that the customer pays *more* for your product because it is advertised? Not at all. No more than he pays anything "extra" for the machinery on your production line!

The truth is, your production tools enable you to *reduce* your manufacturing cost-per-unit — and hence your price to the customer.

Advertising works the same way. For it is simply the application of assembly-line methods to the *manufacture of a sale.*

How can selling be mechanized? Just consider the five basic steps —

1. **Seeking out prospects**
2. **Arousing their interest**
3. **Creating a preference for your product**
4. **Making a specific proposal**
5. **Closing the order**

Advertising performs the first three of these jobs. And it performs them *far more economically* than any other means, leaving your salesmen free to concentrate their valuable time on the two jobs they alone can do, and do best.

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Engineering and Mining Journal

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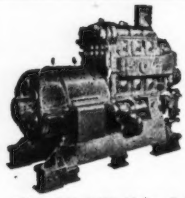

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70#, 60#, 52#, 45#, 30# and 20#. Big selection rail.
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Several complete all steel large buildings, suitable for milling plant. Several hundred tons channels, I beams, columns, angle iron and trusses. Steel ore bins, steel agitator tanks, steel thickener tanks, steel mine lockers.

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2—#75 Marcys, motors available.
3—#86 Marcys, motors available.
1—#76 Marcy, motor available.
2—5'x8' Denver tube mills, motors available.
2—5'x13' Denver pebble mills, motors available.
1—4x4 C.I.W. ball mill.
1—4½x3 Ball Foundry ball mill.
1—7'x36" Hardinge conical ball mill.

PUMPS

1—New 2"x2" Denver type SRL sand pump.
1—New 3"x3" Denver type SRL sand pump.
2—Wilfley #2 sand pumps.
1—Wilfley #3 sand pump.
3—Traylor sand pumps, models 2 and 3R.
2—Allis-Chalmers 6 stage centrifugal pumps, 200 gpm, 560' head.
1—Allis-Chalmers 4x3 centrifugal pump, 500 gpm, 200' head.
2—Delaval 8 stage centrifugal pumps, 1200 gpm, 1215' head.
1—Bingham single stage centrifugal pump, 1000 gpm, 450' head.
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1—Byron Jackson 8 stage submersible pump, 300' head, 500 gpm.
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9—3" Kimball Krough solid lined tailings pumps.
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1—Ingersoll-Rand 2RVH20 pump, 300 gpm.
1—Ingersoll-Rand 1RV ½ motorpump.
2—6"x8" Bingham type HSL pumps, 900 gpm, 90' head.
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1—Hendrie Bolthoff double drum hoist, 60 HP.
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1—Sullivan single drum hoist, 7½ HP.
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Approximately 500 motors, from ½ HP to 300 HP available, nearly all sizes and descriptions.

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Leschen & Sons 43091 lineal feet wire rope tramway.
American Steel & Wire, 16,474' aerial tramway.
5.7 mile tramway, steel towers, complete installation.

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2—Baldwin Westinghouse mine locomotives, 24" gauge, 5 ton.
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2—4 ton Goodman trolley mine motors, 36" gauge or 24" gauge.
6—Baldwin Westinghouse locomotives, 4 ton, 24" gauge.

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10—Granby mine cars, 4 ton, 80 cu. ft., side dump, 24" gauge.
50—Sanford Day bottom dump mine cars, 89 cu. ft., 36" gauge.
38—Truax 1¼ ton mine cars, 18" gauge.
22—15 cu. ft., 18" gauge.
30—8 ton 24" gauge, 157 cu. ft.
16—3 ton, 24" gauge, 47 cu. ft.
Man cars, powder cars.

CRUSHERS

2—8"x20" Blake jaw crushers.
1—Allis-Chalmers 55x24 crushing rolls.
1—New 22" Symons intermediate cone crusher.
1—Assay lab. jaw crusher, Krom 5"x12".
2—Gyratory type Allis-Chalmers #5 style K crushers.
1—Farrel jaw crusher, 13"x30".
1—Denver 8"x10" crusher.

ELEVATORS

1—Belt-bucket elevator, 48' centers.
2—Belt-bucket elevator, 40' centers.
1—Freight elevator, 5000 lb. capacity, electric driven.
1—Belt-bucket elevator, 42' high, 25 HP.
2—Vertical belt-bucket elevators, 166.8 ft., 50 HP.
1—Jeffrey bucket elevator, 20' centers, 7" belt.
1—70' center bucket elevator, 18" belt, 20 HP.

COMPRESSORS

1—Ingersoll-Rand 650 cu. ft., 100 HP air compressor.
1—Ingersoll-Rand 1000 cu. ft., 150 HP, air compressor.
1—Imperial type 10 I.R. compressor, 75 HP.
1—Single cylinder compressor, 9"x12", 40 HP.
1—Chicago Pneumatic 20" & 12"x16", 2300 cu. ft. compressor.
1—Ingersoll-Rand 676 cu. ft., 2 stage air compressor.
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1—Gardner-Denver 100 cu. ft. gas driven, on skids.

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3—Mine skips, top 54"x42", bottom 39"x30".
1—Bottom dump type skip, with man deck.
1—Man skip or car for inclined shaft.
3—Skips for inclined shaft, 30" wide, 43", 40", 46" high.

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1—Complete man cage, hurricane deck.
3—Double deck cages.
1—Single deck mine cage for vertical shaft.
Write for drawings.

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2—50 KW generators, G.E. with 75 HP motors and switchboard panels.
1—35 KW generator, G.E. with 50 HP motor and switchboard.
2—2 KW G.E. generator sets, used for charging lamps.
1—Westinghouse AC generator, 62 KVA with International gas engine.
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1—Westinghouse motor generator set, 12½ KW, 20 HP.
1—100 KW motor generator set, 150 HP motor.
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1—Switchboard panel, 3 phase, 60 cycle, 6900 volt.
2—G.E. 2000 KVA switchboard panel, type ATF.
2—G.E. 2200 volt switchboard panel.
1—G.E. switchboard panel with oil circuit breaker operating lever.
1—G.E. panel switchboard, 25 KVA capacity.

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2—Dorr thickeners, redwood tanks 10'x40', 10 HP.
1—Dorr thickener, redwood tank, 14'x8'.
2—Dorr thickeners, redwood tanks, 24'x8'.
5—Dorr type A thickener mechanisms, complete for 45' tanks.

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3 KVA to 833 KVA transformers, large range sizes and voltages. Also metering and instrument transformers.

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1—36"x10' air receiver, riveted.
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2—5'x12' horizontal air receivers, riveted.
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6—Chicago Pneumatic drills, CP6 drifters.
2—FM-2 wagon drills.
Many 35 to 55 lb. jackhammers, JA50 and S-49 I.R. jackhammers.
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Steam heating plants.
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36"	6	1/8" — 1/16"
30"	6	1/8" — 1/16"
30"	5	1/8" — 1/16"
26"	5	1/8" — 1/32"
24"	5	1/8" — 1/32"
24"	4	1/8" — 1/32"
20"	5	1/8" — 1/32"
20"	4	1/8" — 1/32"
18"	4	1/8" — 1/32"
16"	4	1/8" — 1/32"
14"	4	1/16" — 1/32"
12"	4	1/16" — 1/32"

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Width	Ply	Width	Ply	Width	Ply
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14"	6	8"	6	4"	5
12"	6	8"	5	4"	4
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½"	25 feet	$5.00	$1.50 Pair
	50 "	10.00	1.50 Pair
¾"	25 "	7.50	1.50 Pair
	50 "	15.00	1.50 Pair
1"	25 "	10.00	1.50 Pair
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	50 "	12.50
1¼"	25 "	7.50
	35 "	10.50
	40 "	12.00
	50 "	15.00
1½"	25 "	10.00
	35 "	14.00
	50 "	20.00

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1—350 H.P., single drum, 88" dia., 60" face.
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1—200 H.P., single drum, 42" face, 60" dia., A.C., 2,200 volts and controls.
1—150 H.P., double drums, 38" dia., 42" face, 440 volt, A.C., complete with controls.

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1 8" Georgia Iron Works Pump with 250 HP Motor, Grids and Drum Controller.
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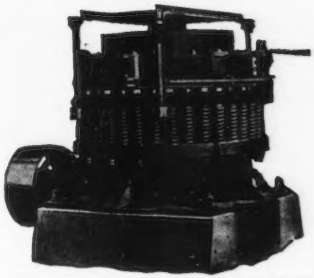

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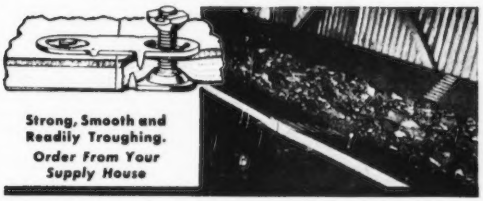

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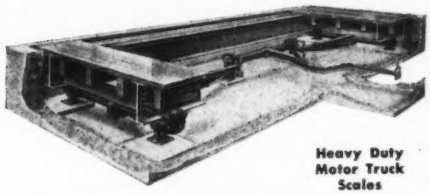

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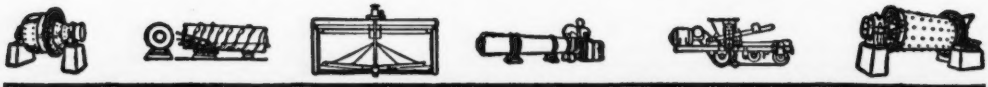

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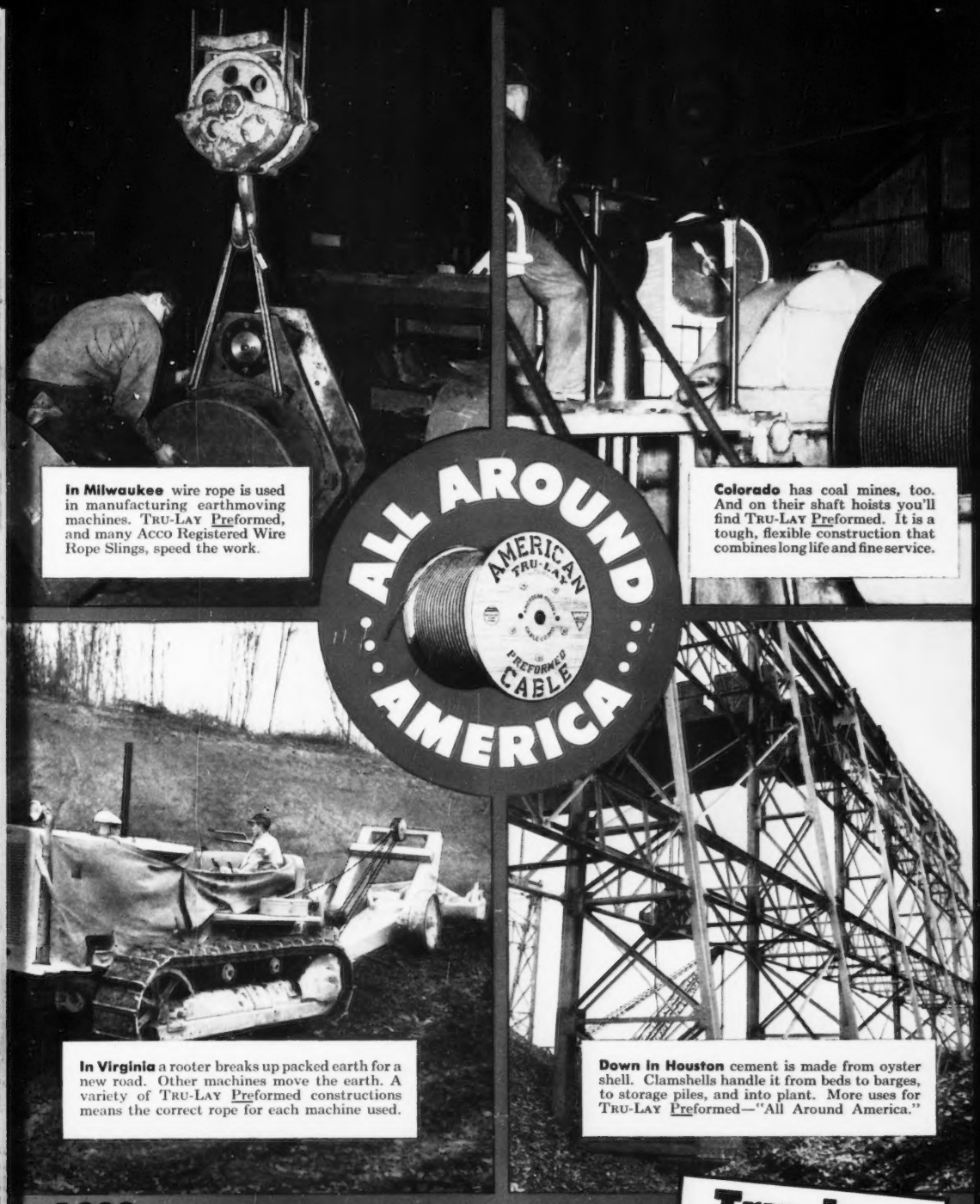

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